Compressed Air Magazine

Vol. 42, No. 12 | London - New York - Paris | December, 1937

HAIFA, PALESTINE, FROM MT. CARMEL

Better track, more quickly laid with

BETHLEHEM STEEL MINE TIES

EVERY move counts in modern, mechanized mining. Each step must follow the preceding with swift precision and traffic must flow without delays. Much depends on the efficiency of the transportation system—on the track being in without delay.

With Bethlehem Steel Mine Ties, track goes down swiftly and easily. Just set the rails in place on these strong but light ties; knock home the clips, and the track is laid firmly and true to gage. Rails can't roll over; can't spread. No costly delays. No time lost in getting the track into service.

For every kind of track in and around the mine, permanent or temporary, Bethlehem Steel Mine Ties excel. Prove this to yourself by installing some at your working faces and in your main-haulage lines. They will pay for themselves many times over in boosted production, in lower track maintenance costs.

BETHLEHEM STEEL COMPANY

ON THE COVER

SWEEPING changes are taking place in the Holy Land under the aegis of the Jewish people. Some of the results of this modernization program are revealed in our cover picture, which shows a part of the City of Haifa framed between "tall Cedars of Lebanon." Further information on the Palestine of today is contained in an article in this issue.

•

IN THIS ISSUE

THE western railroads of the United States have proved themselves singularly progressive in providing high-speed service with light-weight diesel-engined trains. Few people realize that vast changes must be made in railroad alignment before such trains can be made really effective and comfortable. Our leading article tells what the Santa Fe Lines have done to prepare the way for their new *Super Chief* which links Chicago and Los Angeles with a 39¾-hour service.

•

TO stimulate production in newly drilled oil wells it is the practice in some fields to set off charges of nitroglycerin in the oil-bearing formation. The explosive is confined in a metal tube, to that extent offsetting its effectiveness. In a short article on page 5495 is described an improved method by which the nitroglycerin is not only brought in direct contact with the sand but is forced into it with air under pressure, with the result that production is considerably increased.

•

WEBSTER defines a tube as a hollow cylinder, of any material, to convey liquids or gases, or for some other purpose. Our second article seeks to amplify this definition and to describe how modern engineering and construction tubing is manufactured to precise specifications.

•

Christmas Seals

are here again!

They protect your home from Tuberculosis

Compressed Air Magazine

Copyright 1937 by Compressed Air Magazine Company

Volume 42 **DECEMBER, 1937** Number 12

C. H. VIVIAN, *Editor* — J. W. YOUNG, *Advertising Manager*
A. M. HOFFMANN, *Assistant Editor* — J. F. KENNEY, *Business Manager*
D. Y. MARSHALL, *European Correspondent*, 243 Upper Thames St., London, E. C. 4
F. A. MCLEAN, *Canadian Correspondent*, New Birks Bldg., Montreal, Quebec.

EDITORIAL CONTENTS

New Speed on an Old Trail—*Lawrence A. Luther*.....5478
Seamless Tubing for Special Purposes—*C. H. Vivian*.....5483
Driving Chemical Through Piles.....5489
A Cloudland Railway.....5490
Pioneers in Palestine—*Frank A. Ashby*.....5492
Loading Nitroglycerin in Oil Wells with Air Under Pressure—*F. R. Cozzens*.....5495
Editorials—Mines of Palestine—Nickel to the Fore—Yuletide Soliloquy 5496
Curtain of Air Screens Locomotive Cab Lookout.....5497
Hoist Replaces Horses for Hauling Logging Sleigh.....5497
Soldering Iron for Small and Close-Quarter Work.....5498
Portable Brinell Instrument for General Service.....5498
Overhead Lights Easy to Keep Clean.....5498
New Safety Fuse.....5498
Industrial Notes.....5499
Smokeless Chimneys a Possibility.....5499a

ADVERTISING INDEX

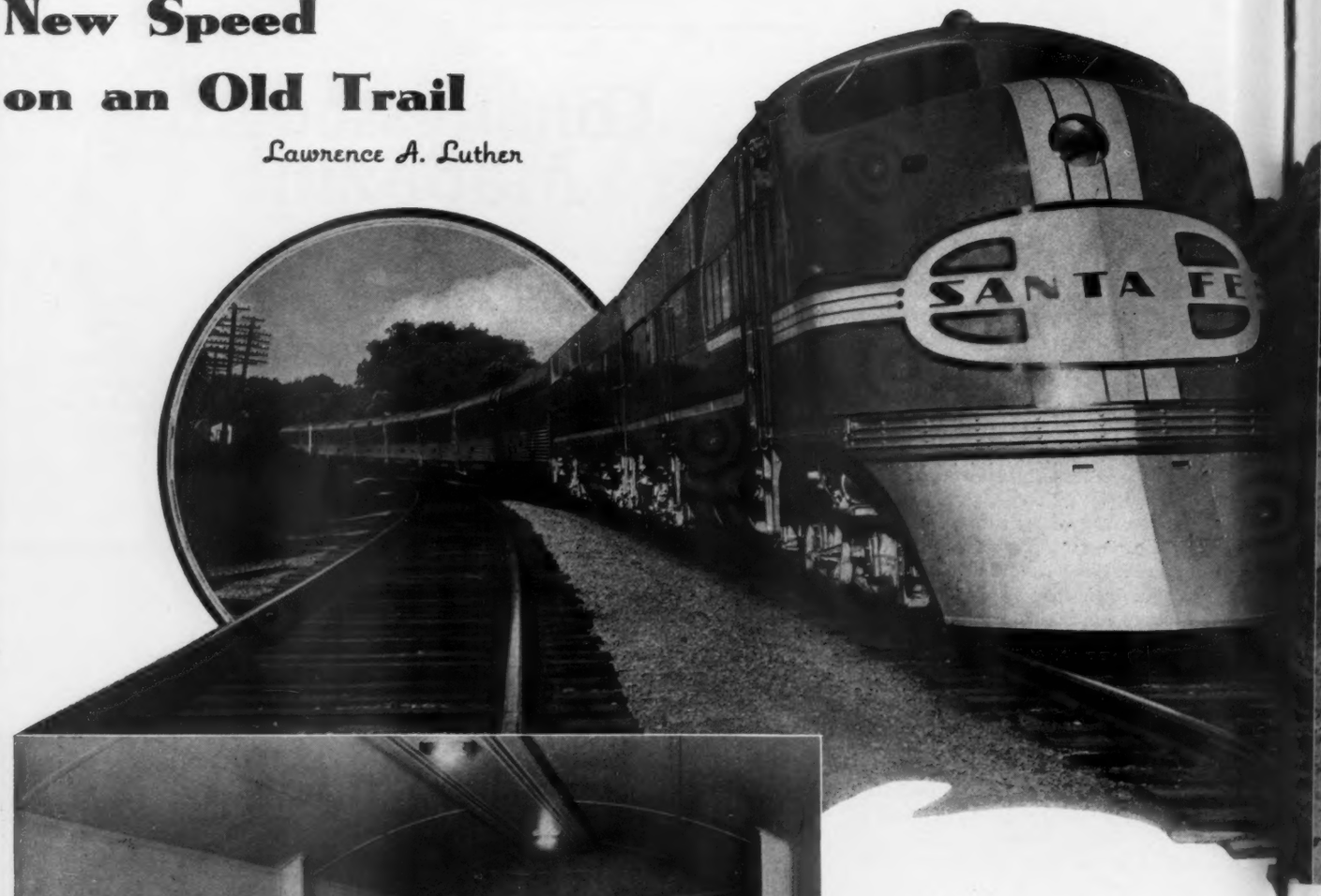
Allis-Chalmers.....Insert Page 4
Atlas Drop Forge Co.....17
Bethlehem Steel Co...Second Cover
Bucyrus-Erie.....24
Coppus Engineering Corporation, The.....11
Diesel Publications, Inc. Insert Page 3
Direct Separator Co., Inc., The..17
Garlock Packing Co., The.....19
General Electric.....26
Gillette Publishing Company....18
Goodrich Co., The B. F.....14
Hercules Powder Co., Inc.....7
Industrial Clutch Co...Third Cover
Ingersoll-Rand Co....6, 10, 15, 20, 23, 27
Jarecki Manufacturing Co.....17
Jenkins Bros.....22
Johnson Corporation, The.....19
Lebanon Steel Foundry.....13
National Forge & Ordnance Co. 25
New Jersey Meter Co.....25
Norton Company.....12
Socony-Vacuum Oil Co., Inc. Insert Pages 1-2
S K F Industries, Inc.....9
Staynew Filter Corporation.....3
Texas Company, The.....4-5
Timken Roller Bearing Co., The..... Back Cover
Torrington Mfg. Co., Inc., The..25
Vogt Machine Co., Inc., Henry..8
Waukesha Motor Company.....16
Westinghouse Electric and Manufacturing Co.....21

A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

Published by Compressed Air Magazine Company. G. W. MORRISON, president; R. A. LUNDELL, vice-president; F. E. KUTZ, secretary-treasurer.
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York, N. Y.
Annual subscription price: domestic, $3.00; foreign, $3.50. Single copies, 35 cents.
Compressed Air Magazine is on file in many libraries and is indexed in Industrial Arts Index.

New Speed on an Old Trail

Lawrence A. Luther

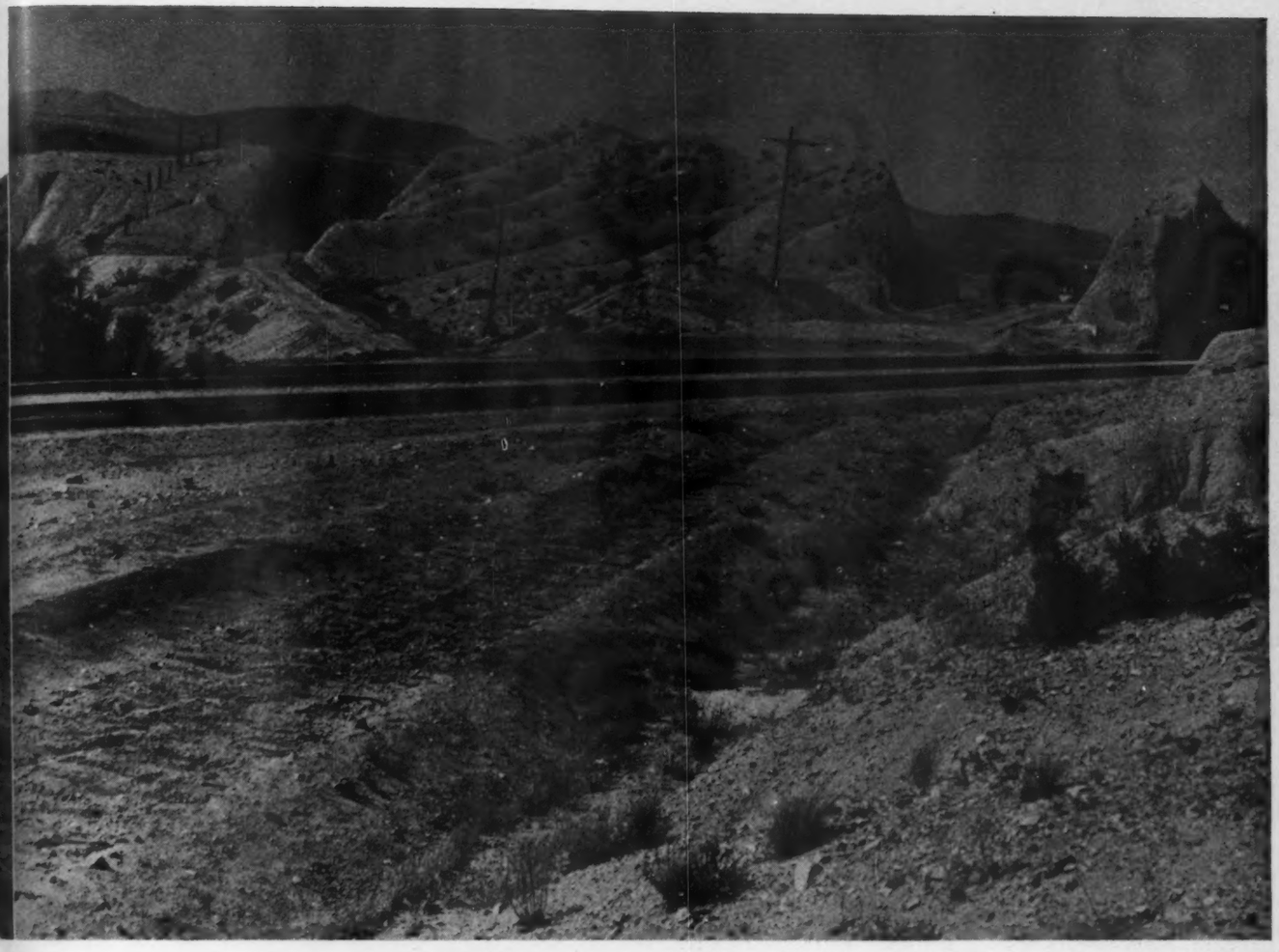


THE "SUPER CHIEF"

The new streamlined train of the Santa Fe Lines that operates on a 39¾-hour schedule between Chicago and Los Angeles averaging 56 miles an hour for the 2,227-mile run. It is made up of eleven cars the first two of which are the 3,600-hp., diesel-electric locomotive. Keeping alive the traditions of the Santa Fe Trail, the railroad has drawn upon Indian art for the decorations of some of its cars. Special attention has also been paid to both day and night illumination. The air-conditioning equipment for each car includes a steam-jet vacuum refrigeration plant. Roofs and side walls of all cars are insulated for both sound and temperature.

WHEN a long, sleek monster of burnished steel flashes through the defile of Glorieta Pass on the Santa Fe Trail, its siren, shattering the afternoon stillness, awakens echoes of both the ultra-modern present and the ancient past. Its blood brother, the airliner, may be cruising right overhead while persistently primitive Indian herdsmen on rocky, scrub-covered slopes listen stolidly to the passing of this newest of baffling new things. Coronado came this way seeking frenziedly for gold; and descendants of his tattered cavaliers perhaps are among the *penitentes* that still rear their crosses on not-so-far-off hill tops. More recently, Apaches listened here for that fastest, boldest traveler of his age, the lone Pony Express rider; and their arrows contested the passing of Kit Carson and the wagon trains crawling up to old Santa Fe and the unchartered West beyond. You ride on this newest continent-spanning streamliner close by the Glorieta battlefield, where calloused Colorado miners repulsed wayworn Confederate invaders in the westernmost battle of the Civil War.

So the management of the Santa Fe Lines, in moving Chicago and Los Angeles closer together until they are but 39¾ hours apart by rail, are only the latest arrivals in a 400-year-old pageant of intrepid crusaders that have followed this trail.



RAILWAY ORTHOPEDIC SURGERY

This picture tells the complete story of the evolution of a modern railroad line. It was taken on the Santa Fe between Victorville and Barstow, Calif. The cut at the left shows the original winding route. Next to it on the right and slanting downward toward the foreground is the recently abandoned grade. The new line eliminates all curvature at this particular location.

Coronado excepted, they have been inspired to a marked degree by creative rather than by mercenary motives; and the Santa Fe, in making available to the public this diesel-engine-powered, stainless-steel train designed especially for extra-fare transcontinental travel, and by providing extensive improvements to facilitate high-speed operation, upholds the tradition of its road and of the old trail it supplanted. The Santa Fe Trail had its beginning as a travelway in the eighteenth century; but we find it today still in process of development. Even though Cyrus K. Holliday took over the task of converting the winding, rutted route into a railway in 1859, the fact that there was no connection with the Pacific Coast until 1885, and none with Chicago until 1887, makes the Santa Fe System appear relatively young but not in the least static.

To summarize very briefly the story of the Santa Fe route: For a dozen years after the War of 1812 it was a pack-mule trail from Kansas to Santa Fe. In 1848 it became a wagon road for pioneers, traders, and the military. A typical year's haulage over it totaled 18,000 tons in 1860—enough to load only ten trains but requiring 67,950 wagons to transport it. From the middle of the century until 1872, stagecoaches maintained a snappy, 30-day schedule between Independence, Kans., and old Santa Fe, providing Indians or floods did not interfere. Then came the building of the Santa Fe railroad, which has continued for some 30 years as a singularly coöperative, pay-as-you-go enterprise. It was typical of the days when hopes were high but money scarce that Holliday's party, going to Atchison to form a company in 1860, supposedly traveled in a donated livery rig and carried cold lunches. As the line crept westward from Topeka, financed largely by bond issues from towns and counties it served, its best promotional point was that it began at once to pay.

In the current program of improvement, the primary object of which is elimination or reduction of curvatures, the same spirit of thrift applies; and though the most spectacular effect of each completed part of this project is that it permits operating the new streamlined *Super Chief* at 100-mile-per-hour speeds, still a faster tempo and increased economy in handling all freight and passenger business are perhaps more vital and more dividend-paying results.

As this 2,227-mile route between the nation's second- and third-largest cities traverses greatly diversified terrain, it accordingly varies from long tangents across relatively level plains to the more or less serpentine lines required to cross the southern outpost of the Rockies at Raton Pass, on the Colorado-New Mexico line, and four other mountain ranges. The horse-drawn plows and scrapers available to the early builders of the line seem hopelessly inadequate when compared with the modern earth- and rock-handling equipment used by the contractors on the current undertaking; and the entire concept of what a railroad should be has undergone a no less sweeping change. Certainly it

CUSHIONING THE ROADBED

Proper ballasting is essential to smooth train operation. It also insures good drainage, which is vital to the maintenance of the grade and track structure. These pictures show Santa Fe crews tamping ballast beneath ties with modern pneumatic equipment. Note how the men work in pairs opposite each other. Depending upon conditions, the air compressor that supplies power to the tools may be mounted on railway wheels or on a tractor that travels alongside the grade.

was beyond the liveliest imagination of the builders that a curvature as slight as 3 degrees might ever impose severe speed restrictions. Many more or less extensive line changes have been made from time to time prior to the inception of the present program; and it is significant of the rapid transition characterizing every phase of American railroading that standards governing this Santa Fe project have been made more severe even since work on it began.

Wherever practicable, the maximum curvature in the relocated line is now being held to 1 degree, 30 minutes. In certain locations, however, where a curve between long, near-level tangents entailed a reduction in speed, an additional expenditure has been authorized to permit cutting a curvature of 1 degree. Intensive study has been necessary in selecting locations for curve-reduction work. Alignment and profile data are employed in working up speed diagrams; and locations that would seem to offer the best dividends on the investment in line change are discussed with operating and engineering officials and checked further by field parties.

Stated broadly, a reasonable expenditure for the reduction or elimination of one or more curves is authorized if it will serve to prevent a restriction in speed below that possible on both sides of the location studied. Individual jobs range from small changes affecting one curve only to those embracing the reduction or elimination of numerous curves and alteration of grade by complete relocation of several miles of line. Some operations of the latter sort have involved more than 150,000 cubic yards of earth and rock removal.

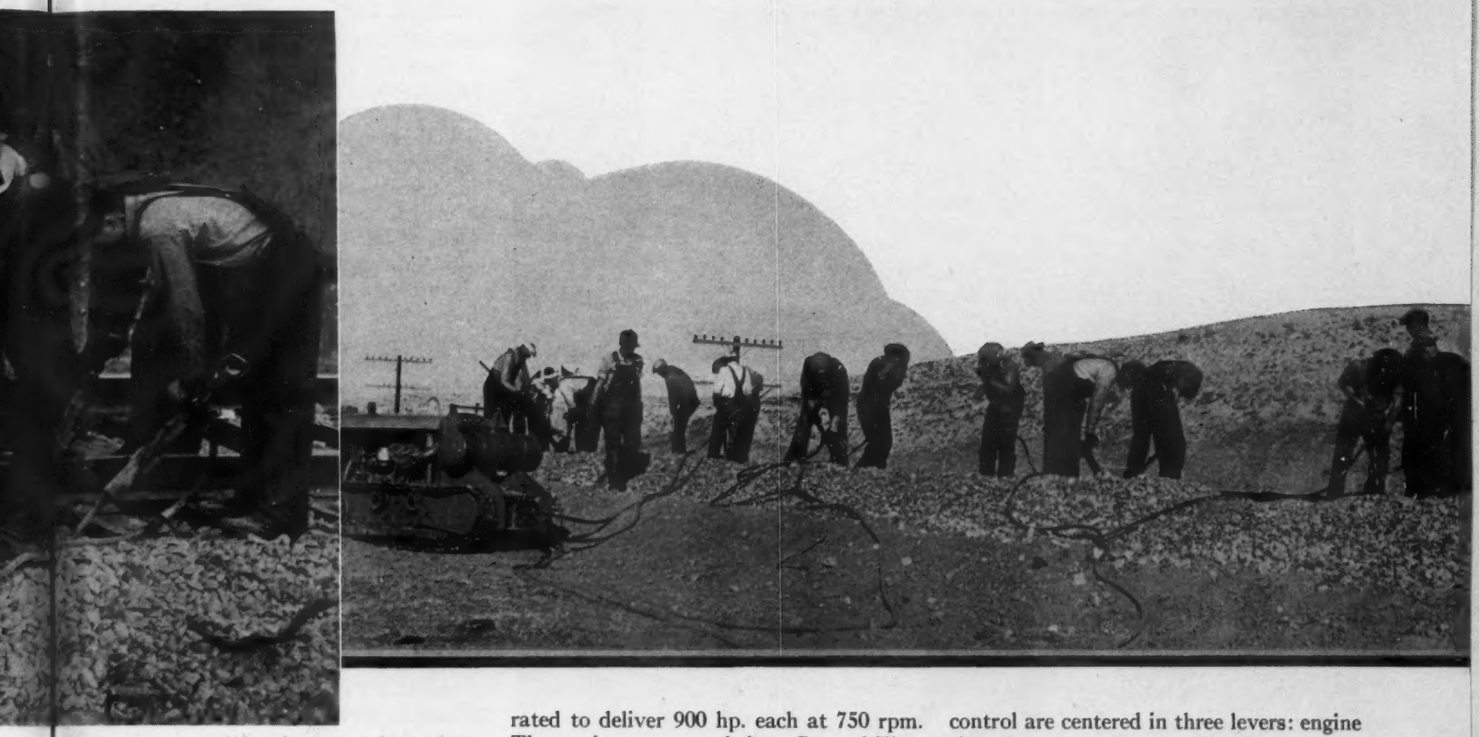
Jobs entailing heavy excavation and embankment work are let to various contractors: all track work is done by the railway forces. Where new track is required, it is laid on new grade; but where the change in location of the line is not too great, it is more economical to shift the old track structure intact. This is a simple enough procedure when it has to be lined over only a few feet, in which case the work is done by hand; but where a long curve has to be moved, the preparations are quite elaborate. Steel rails are placed at right angles to the track to serve as skidways, and as soon as the track is cut and the signal given, a planned attack with tractors, power cranes, and men hustles it across to its new position with dispatch. As a result, curves are sometimes shifted a maximum of nearly 100 feet. The method as now employed was developed through the interchange of ideas among the divisions on the job, and is effecting considerable savings in both time and money.

Counting eastbound and westbound track in double-track territory as separate units, some 500 curves have thus been either reduced or eliminated and, incidentally, the total distance somewhat shortened. The elevation or bank given all curves has been altered to conform to new standards, and signs called speed boards, that show the permissible speeds for both passenger and freight trains, have been moved back some 3,000 feet from points where the speed restrictions apply.

Typical of the standards governing curve elevation is a bank of 4½ inches for a curve of 1 degree 30 minutes, with a permissible speed of 85 miles per hour. The spiral or taper which joins these elevated sections to level track has been lengthened to assure smooth and comfortable operation at high speeds. Accelerated train speeds have made it necessary to change the system of automatic signals—a feature increasing safety being a 3-block system. This indicates by signal lights or arms occupancy not only of contiguous blocks but also of the second and third blocks removed.

Strength and smoothness of the track structure over which the new streamlined train operates are no less essential than freedom from excessive curvature, and heavy expenditures have been made during the past three years for the laying of rail weighing 112 pounds per yard, for new ties, and for extensive surfacing work on both new and old rails. In this latter phase of the track-improvement program, modern compressed-air-powered equipment has played perhaps as vital a rôle as it did in simplifying the rock excavation necessary in making line changes. In laying new rail, spikes are driven by pneumatic hammers, while all large tie-tamping jobs have been done by extra gangs using pneumatic units of 16-tool or 8-tool size. These have been supplemented in many instances by small compressors operating four tie tampers.

The final measure of all work performed to improve this line is taken by the flashing *Super Chief* with its capacity for utilizing every new facility provided for clipping

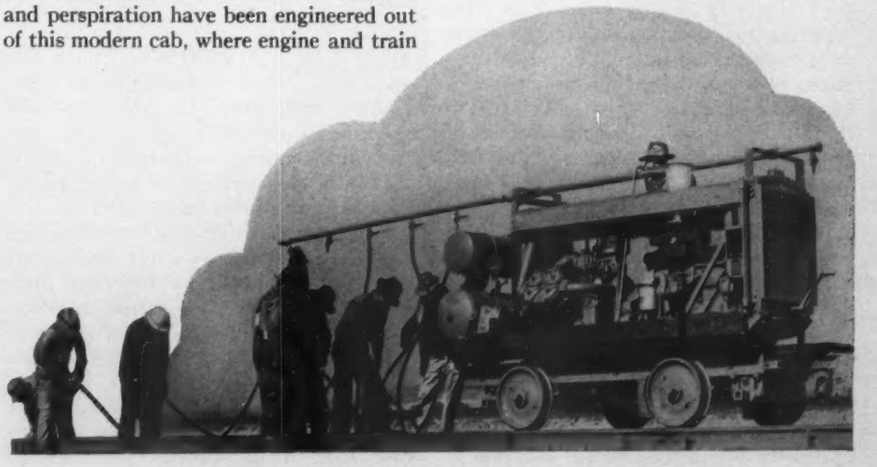


minutes from the Chicago-to-Los Angeles time; and the effect on railroadmen of a ride in its locomotive cab is such as to make them revamp more or less their entire conception of right-of-way requirements. The new train in its present form is the result of a considerable period of development; and in maintaining its exacting schedule on many runs with conventional passenger equipment and Pacific type steam locomotives with large, precisely balanced drivers, the mechanical-department personnel all along the line has demonstrated that the leaven of determination and resourcefulness is as strong a railway asset now as it was in the pioneer days.

The train, as placed in scheduled service on May 18 of this year, consists of a 3,600-hp., diesel-electric locomotive made up of two 1,800-hp. units arranged for synchronized control but capable of separate operation; of one mail car; one combination mail-and-baggage car; two cars containing sections, compartments, and drawing rooms; one car with lounge, barber shop, bar, and specially designed quarters for a crew of twelve; one diner; and of three cars providing combination bedrooms, compartments, and drawing rooms—an observation lounge occupying half of one of these cars. The train will accommodate 104 passengers. The combined length of the two power units is 140 feet 8 inches. The total train is 855 feet 8 inches long, the cars having varying lengths of 73, 79, and 83 feet. The aggregate weight of the 11-car train, fueled and watered, is 1,419,000 pounds, of which 568,000 pounds constitutes the locomotive.

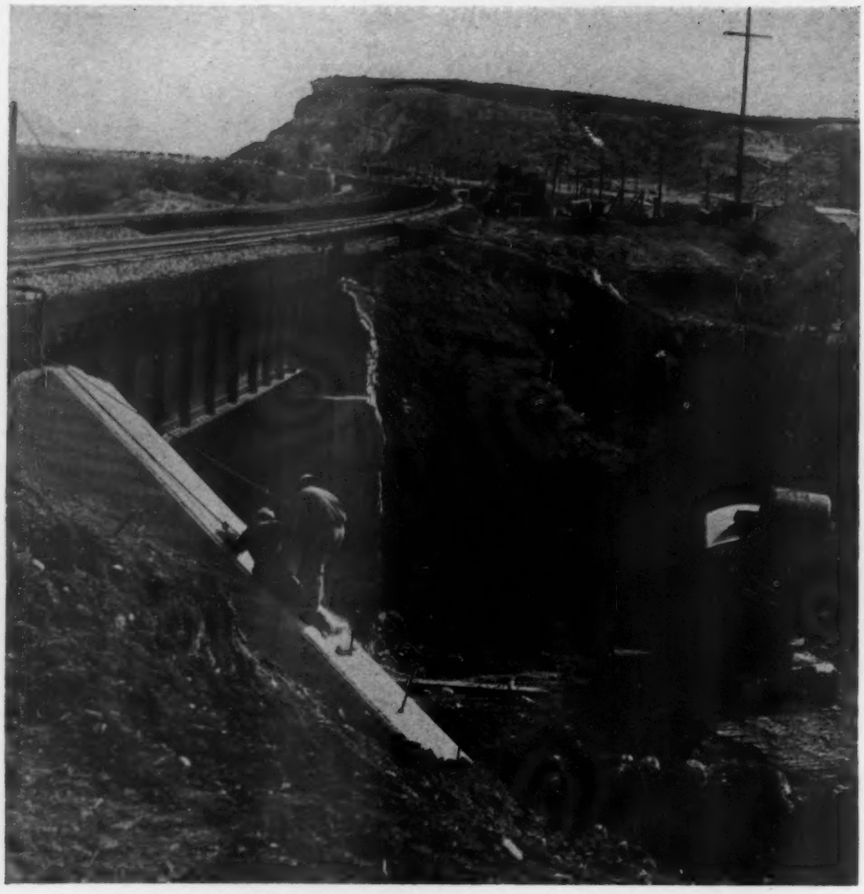
Each power unit contains two 12-cylinder, 8x10, V-type, 2-cycle diesel engines rated to deliver 900 hp. each at 750 rpm. The engines are coupled to General Electric 600-volt, direct-current generators having differential voltage control through belt-driven exciters and auxiliary generator sets. The two generators in each power unit deliver current to four 450-hp., fan-cooled motors mounted with gear drive on the two outside axles of each 6-wheel truck. The generators also serve as electric-engine starters when supplied with battery current. The engines are watercooled, with pump circulation through fan-cooled roof radiators equipped with thermostatically operated shutters. This bit and bridle placed on this great concentration of horse power must seem to make operation almost too simple to old-time enginemen still vividly remembering the back-breaking "Johnson bar" and other cumbersome intricacies of hand-stoked steam locomotives. Exertion and perspiration have been engineered out of this modern cab, where engine and train control are centered in three levers: engine throttle, reverse lever, and brake.

Sitting in an upholstered seat, the pilot of this twentieth-century train has unobscured vision through a shatterproof windshield with an automatic wiper and defroster. Movements of the main locomotive throttle are relayed by electropneumatic hook-up to all four engines, with precedence over this main throttle given to manual switches in local control stations at each engine. There, attendants check the performances of the several engines by means of fuel and lubricant gauges, tachometers, cooling-water thermometers, and pyrometers indicating the exhaust temperature of each cylinder. Manual inspection is supplemented by an automatic alarm system that serves to ring a gong and to in-



DRIVING SPIKES

Using air-driven tools, well-organized crews can drive spikes more rapidly and more effectively than by the older hand method. The compressor is self-propelled and can be moved ahead at any desired speed as the spiking operation proceeds.



RELOCATING A BRIDGE

The necessity for moving bridges and other fixed structures adds to the complexity and expense of track relocation. The picture shows operations near Manuelito, N. Mex., where a bridge had to be shifted to the right to eliminate a curve in the line. This work was done under contract by Sharp & Fellows. The men in the foreground are drilling the concrete abutment with a Jackhamer, while a paving breaker is being used on the opposite side of the gulch to loosen hard adobe.

dicate the nature and location of trouble with colored lights. A wheel-slip indicator is another automatic feature.

The side frames of each locomotive unit are of truss construction designed to carry the entire body weight, the machinery being supported on cross members. The outer walls of these cars are built of panels combining plywood, treated canvas, and stainless steel held in place by battens riveted to the frame. A specially designed assembly of equalizers and alloy-steel springs is utilized for load suspension; and a leaf has been taken from the automotive book in the use of hydraulic shock absorbers to cushion lateral oscillation of bolsters and the thrusts of high-speed operation on curves. The locomotive-wheel bearing load is 22,500 pounds for idle center axles and 23,400 pounds for drive axles, double-roller SKF bearings being employed in the journals. The entire train is provided with clasp brakes which are actuated by a new Westinghouse hook-up known as Schedule 8-EL. This had to be devised in order to meet the requirements of certain sections of the line that are equipped with train control. Steam for heating is provided by 225-pound-pressure flash-type steam generators in each locomotive unit.

All other trains built by the Edward G. Budd Manufacturing Company have had car ends articulated on a common truck; but *Super Chief* cars are individual units and may be cut out of the train in the convential manner. Trucks used on these cars are of the 4-wheel, double-equalizer type, and here again hydraulic shock absorbers supplement alloy-steel elliptic and coil springs in achieving desired riding qualities. These new cars might be termed a bearing laboratory on wheels, as the first five are equipped with friction-type Satco bearings while the last four have a dual bearing arrangement, developed by American Steel Foundries, in which plain journals, in effect, stand by to take over in case of failure of the roller bearings that are housed in tubes between wheels.

Strength combined with lightness was the prime objective in constructing these cars; and, though various other special alloys are employed in frames, stainless steel fabricated by the Shotweld process predominates. All hollow areas in structural members are packed with sound-absorbing material, and roofs and side walls have a generous layer of heat and sound insulation, while inch-thick cork floors and ¼-inch special floor pads further insulate car interiors. This insulation contributes to the effectiveness of the steam-ejector air-conditioning system that is incorporated in the basic design of the cars—not added as best it may be, as is the case with most equipment of this kind now in service. Typical of fastidiousness, even in hidden details, is the carrying of the passengers' water supply in stainless-steel tanks. Car doors are designed to fit flush and present no break in body surface, while steps fold up neatly when not in use. Car roofs are of corrugated material, and outer walls are assembled artistically from flat and corrugated sheets of unpainted stainless steel.

Common sense and art combined have made for interior appointments that are both smart and comfortable. A concession to tall men is found in the 6-foot-5-inch berths; and windows for upper berths is another contribution to well-being. Upper berths are constructed on flat trays which move up flush with the ceiling in the daytime and are supported when in use by partitions between sections. The latter have been given a greater measure of privacy by their partway enclosure with longitudinal partitions.

The names chosen for the passenger cars are those of Indian tribes and towns along the Santa Fe route; and, in keeping with them, the native arts of the Southwest have been drawn upon in decorating the interior of the train. Specially woven Indian fabrics curtain the wide windows and cover the upholstery, and ceremonial patterns and hand-loomed Navajo rugs add to the artistic effect. The impression gained by even a casual inspection of the train is that monotonous standardization has been avoided in the matter of interior decoration, each car being individual in this respect. Especially appealing to feminine tastes are the combinations of colors, soft fabrics, exotic woods, and satin-finish chrome hardware. A passenger with culinary tastes will perhaps be as much intrigued by the gleaming metal of the galley as by the spacious dining car with its china of ancient Indian pattern. The entire table service, incidentally, was designed by a woman, Miss Coulter, who has been doing Southwestern interiors for Fred Harvey for 35 years.

The *Super Chief* does not operate on an unduly fixed schedule, for it cut three hours from its 39¾-hour time on a preliminary test run. Though this unique train and this direct, almost winterless route seem quite the last word in transcontinental train travel, the Santa Fe management recognizes that even seeming perfection can be improved upon, and so you will still see from your car window—perhaps where picturesque Navajo shepherds watch their flocks—occasional parties of bronzed young engineers staking out newer avenues of speed on this old trail.

Seamless Tubing for Special Purposes

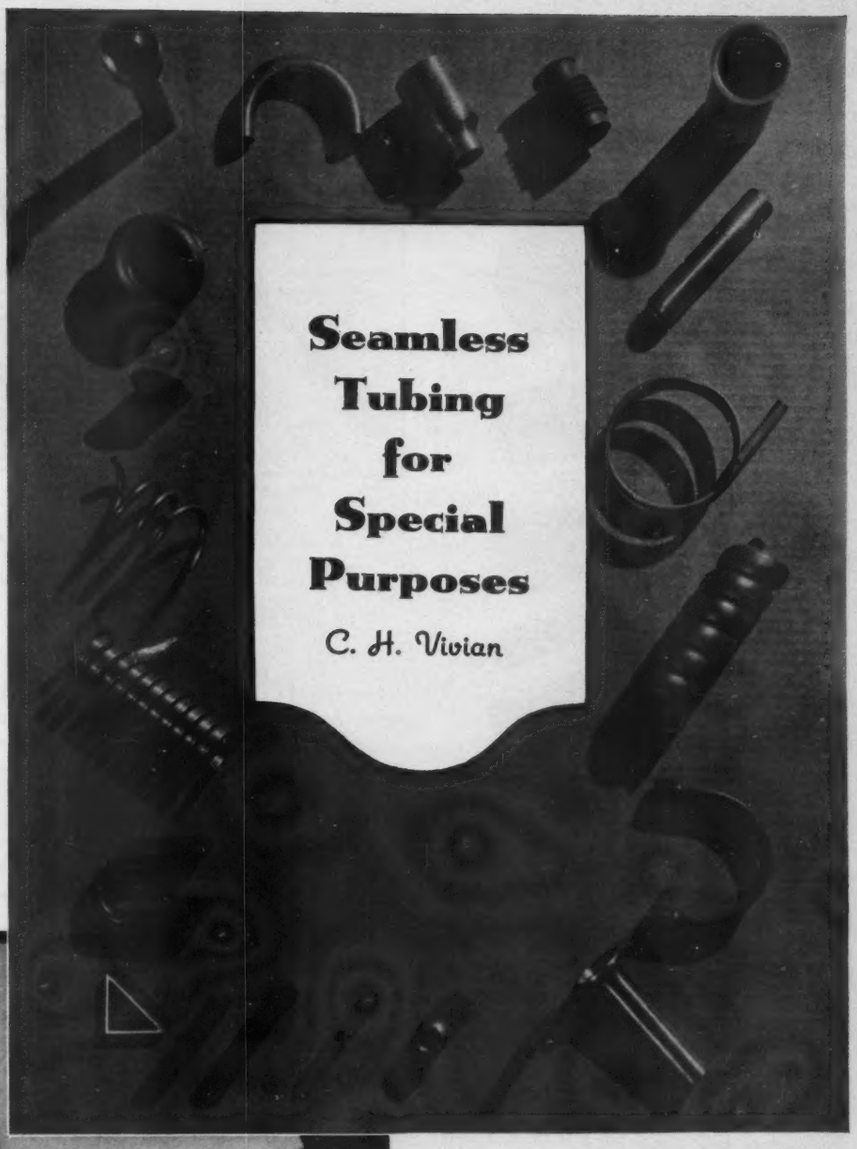
C. H. Vivian

ONE of the first questions that comes to mind when one undertakes to write something about tubing concerns the difference between a tube and a pipe. The dictionary is of little help, as it defines each in terms of the other. In industry, however, there is a definite distinction, a tube being a product of greater refinement than a pipe. The difference has to do with the process of manufacture rather than with any marked variation in shape or general outward appearance. The additional attention paid to its making does, however, earmark a tube so plainly that one experienced in such things can tell at a glance that it should not be referred to by the plebeian term pipe.

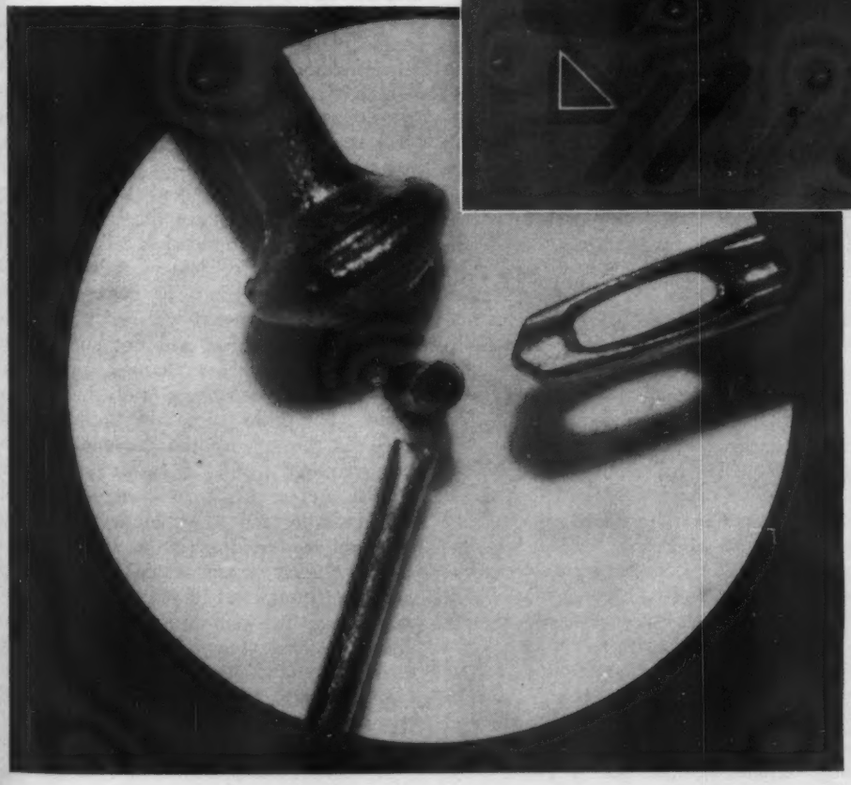
Another thing that impresses the reporter on tubing is the discovery that the degrees of refinement differentiating a tube from a pipe are so numerous as to give rise to special forms of tubing. To illustrate the point, we cite the fact that the Summerill Tubing Company of Bridgeport, Pa., not only makes tubing exclusively but also makes just certain kinds of tubing. In the company's own words, it is a "specialist in tubing specialties."

But despite the limitation that such specialization seemingly places on its activities, the variety of Summerill tubing is so great as to be striking. Even the diversity takes many forms, according to whether one considers tubing from the viewpoint of the materials from which it is made, the use to which it is to be put, or its size. Any breakdown of the product leads one into a labyrinth of details, for there are more individual types and sizes of tubing than there are pieces of cloth in a crazy quilt.

Take the matter of size: A solid metal section, such as a rod or wire, has only one dimension of thickness—the over-all diameter. Tubing, however, has three: outside diameter, inside diameter, and wall thickness, and each is very important to the user who requires tubing for specific services. For example, Summerill has furnished tubing with a wall strong enough to withstand a hydraulic operating pressure of 120,000 pounds per square inch, and, at the other extreme, it has supplied tubing



Courtesy, International Nickel Company

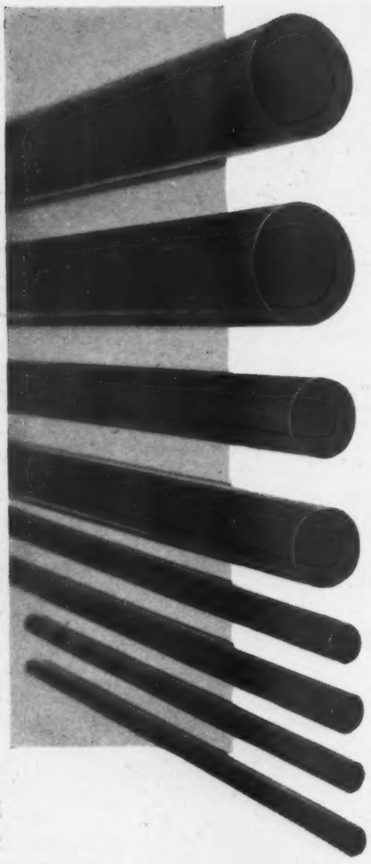


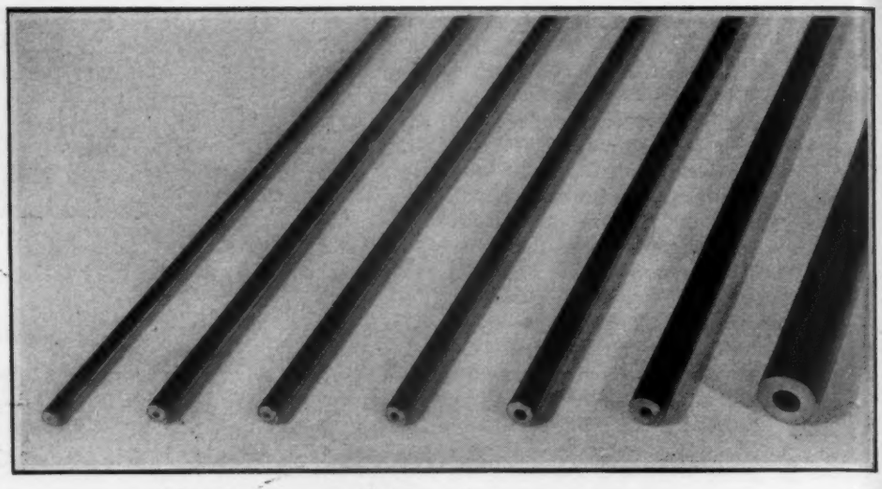
TUBE PRODUCTS

One ordinarily thinks of tubing in its straight form, but much of it is made into special shapes before use. Depending upon the nature of the subsequent operations, the mill furnishes the tubing in any one of a wide range of hardnesses.

MINUTE TUBING

A head of a pin, an eye of a needle, and a piece of needle tubing, all shown fifteen times their actual size. In the center is a cross section of the tubing, revealing that the hole is comparatively large and well defined despite the extremely small outside diameter.





EXTREMES IN WALL THICKNESS

The flexibility of the cold-drawn process, when properly controlled, is illustrated here. The two groups of tubes exhibit marked differences in the relation of wall thickness to outside and inside diameters. Despite their diversity, both groups can be and often are made from tube billets of like section. Shown above are specimens of high-pressure tubing for such applications as injecting fuel oil into diesel-engine cylinders.

with a wall so thin that it will pulsate under slight pressure fluctuations.

If we consider further that tubing is made of numerous metals and alloys all of which differ in physical characteristics, and that it is turned out not only in round sections but in ovals, squares, ellipses, hexagons, and in numerous special shapes, then we begin to comprehend the almost limitless number of sizes and grades of this product obtainable. The Summerill general catalogue lists round tubing ranging in outside diameter from 6 inches down to 0.012 inch; and each of the myriad sizes comes in a wide range of wall thicknesses. The 0.012-inch size is produced with a wall thickness of as little as 0.003 inch.

Even more minute tubing is made on special orders, one of which recently called for 5,000 feet of tubing having an outside diameter of 0.0075 inch and a wall thickness of 0.0015 inch. This did not set a record for smallness, however, as the mill has produced tubing of 0.005 inch outside diameter and 0.0008 inch wall thickness. Such small tubing is called needle tubing and, as the name implies, is used, among other things, for making hypodermic needles. In addition to its services in medicine, it is employed for injecting liquids into the centers of golf balls to give them high resiliency or, in golf terminology, distance. Another application has been found for it in delicate textile machinery, where it serves as thread guides.

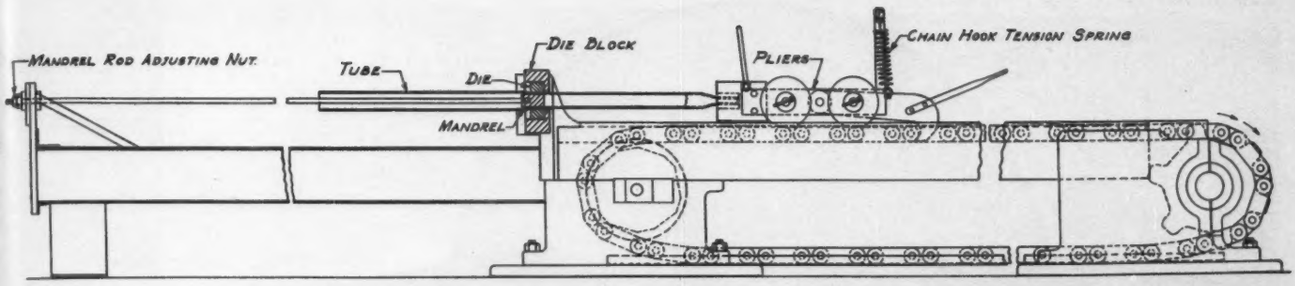
Finally, if we take into account that tolerances in diameter and in wall thickness are held to as little as one four-thousandth of an inch, and that concentricity, smoothness of finish, and hardness are controlled within very close limits, then it will be apparent that there is not much exaggeration in the company's claim that it "does in daily production what many practical men would consider possible only in laboratory work."

All Summerill tubing is of the seamless type. It is produced by the cold-drawing process, and the greater proportion of it is made of steel or steel alloys. The steel tubing can be roughly classified under the two headings of mechanical tubing and pressure tubing, although there is some overlapping, particularly in the case of what is known as instrument tubing. Under this heading comes tubing that is employed in connection with pressure gauges and control instruments, where its function is to translate internal pressure into mechanical movement that actuates the indicator or valve mechanism.

One form of such tubing is called Bourdon tubing. It commonly consists of a tube of flat-oval section that is bent in the form of a "U" or coiled in a helical spring. When such a tube is subjected to internal pressure it attempts to straighten out. By anchoring one end, this tendency is imparted to the free end, and the force thus exerted is registered on the gauge or instrument to which it is connected. Tubing for such purposes was formerly made only of brass, copper, and bronze. In recent years, however, it has been necessary to provide instruments that will withstand pressures up to 50,000 pounds per square inch. There has also been a demand for instruments of greater sensitivity that will retain their accuracy longer and have a longer period of usefulness. These requirements have called for tubing that will stand up under repeated and constant flexing and that can be made uniform as to size and composition. As a consequence, instrument makers have turned to alloy-steel tubing for high-pressure service.

Similar to Bourdon tubing is the capillary tubing that is used with instruments for recording or controlling temperatures. A steel bulb is located at the point where the change in temperature takes place, and this is connected with the U-tube or spring tube by the capillary tube. All three of these elements are filled with mercury, which expands or contracts as the temperature rises or falls. The pressure changes thus brought about within the tubing affect the U-tube or spring tube in the manner previously described, and the latter, in turn, serves to actuate the gauge or instrument. This application calls for small tubing with relatively heavy walls that will not expand, contract, or rupture under pressure changes, that will resist mechanical abuse, and that will not sufficiently transmit temperature changes along the line to affect the accuracy of the instrument. The tubing must also have a small bore, as the smaller the amount of mercury required to fill the system, the more precise and sensitive the instrument will be. In order that the mercury may flow as readily in one direction as in the other, the bore must be very smooth, clean, and accurate throughout its length. Such tubing is furnished with an inside diameter as small as 0.005 inch and an outside diameter as small as 0.065 inch. It is made of stainless or carbon steel, or of laminations of two different metals such as carbon steel and copper.

An outstanding application of tubing for structural purposes is found in airplane fabrication. Its use in this field came about in Great Britain during the World War, when a shortage of wood compelled manu-



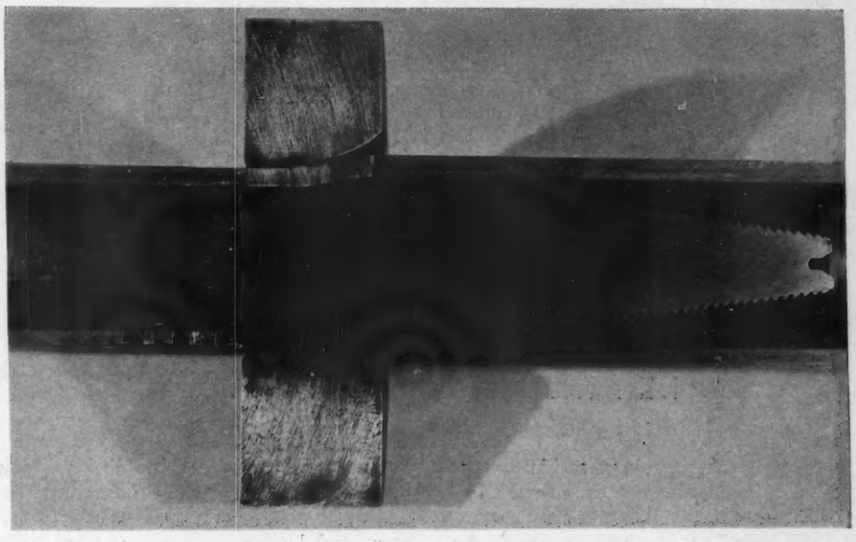
facturers to turn to other materials. Manifestly, this was a distinct advance, as the high weight-strength ratio of tubing has enabled the aircraft industry to build planes of better design and at the same time to replace much dead load with pay load. Some planes contain as much as 5,000 linear feet of tubing.

Aircraft tubing is made in various special shapes. One of these, called streamline, might be loosely described as egg-shaped, although it is more elongated. More accurately defined, it is in the form that a drop of liquid assumes when falling from a height. Streamline tubing is used with the larger or leading edge pointing into the wind to reduce air resistance. The first streamline sections made in this country were processed by Summerill in collaboration with and under the supervision of Government engineers. Other special shapes of tubing entering into aircraft manufacture are round-cornered squares, ovals, and ellipses.

Most aircraft tubing is now made of chrome-molybdenum steel, which, in addition to having a very high weight-strength ratio, is especially suitable for assembly by welding, particularly as it will harden in the air after such treatment and therefore virtually retain all its original strength. For some parts, such as axles, landing gear, etc., the tubing is often heat-treated to give it an ultimate strength of as much as 200,000 pounds per square inch.

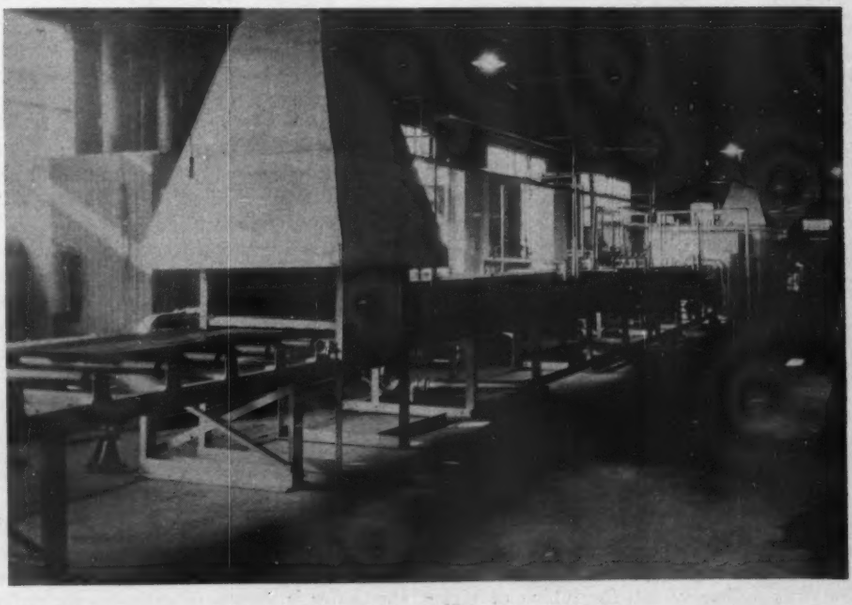
An insight into the superior physical properties of chrome-molybdenum tubing is given by a Summerill display board made up for exhibition purposes. On it are mounted three sections of tubing of equal strength. All are 1 inch in outside diameter but have different wall thicknesses. The first, of mild carbon steel, has a wall thickness of 0.109 inch and weighs 1.04 pounds per linear foot. The second, of normalized chrome-molybdenum steel, has a wall thickness of 0.065 inch and weighs 0.65 pound per foot. The third, of heat-treated chrome-molybdenum steel, has a wall thickness of 0.032 inch and weighs 0.33 pound per foot. It will be apparent from the foregoing data that a saving of approximately 60 per cent in weight can be made by using the third instead of the first, or of 30 per cent by using the second instead of the first.

Interesting applications of steel tubing



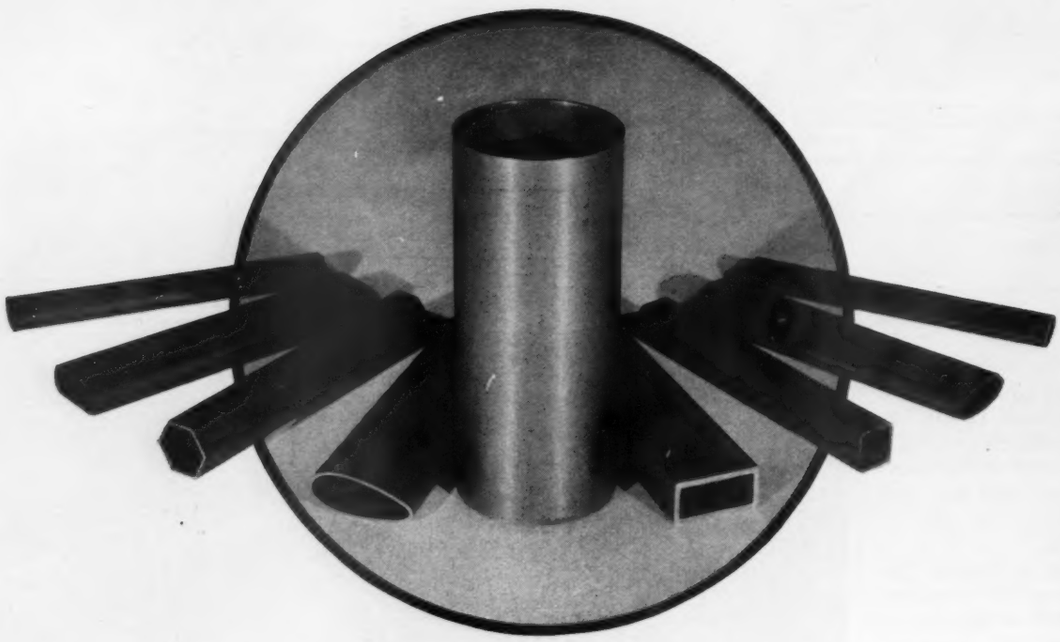
HOW DRAWING IS DONE

After one end has been reduced in size by swaging, and a mandrel has been run inside it, the tube is inserted through the die (see drawing above). The projecting tip is gripped by the jaws of the pliers, which is a wheel-mounted truck that runs on rails. A hook at the rear end of the pliers engages an endless chain, which is moved by power applied to the sprocket wheel at the right end. The photograph shows a section through a die, tube, and mandrel, and illustrates how the outside and inside diameters and the wall of a tube are reduced simultaneously.



ANNEALING FURNACE

The discharge end of a modern, continuous electric furnace in which the temperature is automatically controlled. By maintaining an atmosphere of inert gas within the furnace, oxidation is prevented and the tubing is kept in a clean, bright condition. After being heated to the desired temperature, it is cooled by passing it through a chamber in the walls of which cold water is circulated.



VARIED SECTIONS

A few of the widely diversified forms in which tubing is made. In all cases, it is first drawn round and then shaped, as desired, by passing it through appropriate dies.

that are growing in volume and importance are found in the realm of sports. It is chiefly used for making golf-club shafts, having supplanted wood in the better-grade product. By tapering the tubing, the shaft is given flexibility or "whip" that increases the speed of the club head at the instant of impact with the ball and thereby brings about a longer shot. Thus tubing is helping to improve both the balls and the clubs which give thousands of persons pleasure and annoyance in their leisure hours. Summerill furnishes all the tubing required by one of the nation's largest manufacturers of golf clubs. It is supplied in outside diameters of from 0.5 inch to 0.625 inch and with walls ranging from 0.014 inch to 0.025 inch in thickness. Including the work done on them by the club maker, some shafts undergo more than 100 operations before they are ready for the market.

Tubular-steel fishing rods for bait casting are now on the market, and anglers are reported to like them. They weigh no more than split-bamboo rods of corresponding lengths. Smaller and longer rods of the type used for fly casting for trout are in process of development but have not yet been generally introduced to the trade. Tubing is also being used in making tennis and badminton racquets.

Pressure tubing has a wide application in industry, some of its principal uses being the making of boilers, heat exchangers, refrigeration equipment, and the like. Such services ordinarily call for tubing of very smooth bore that will not impede the high-velocity flow of liquids. Smoothness also is a factor in retarding corrosion, which usually starts at pits. As carbides are particularly susceptible to corrosive attack, low-carbon steels are preferable for tubing for such purposes. Where conditions necessitate it, tubing is also furnished in a variety of corrosion-resistant steels, ranging from those containing small amounts of copper or nickel to the so-called 18-8 stainless variety that contains 18 per cent chrome and 8 per cent nickel.

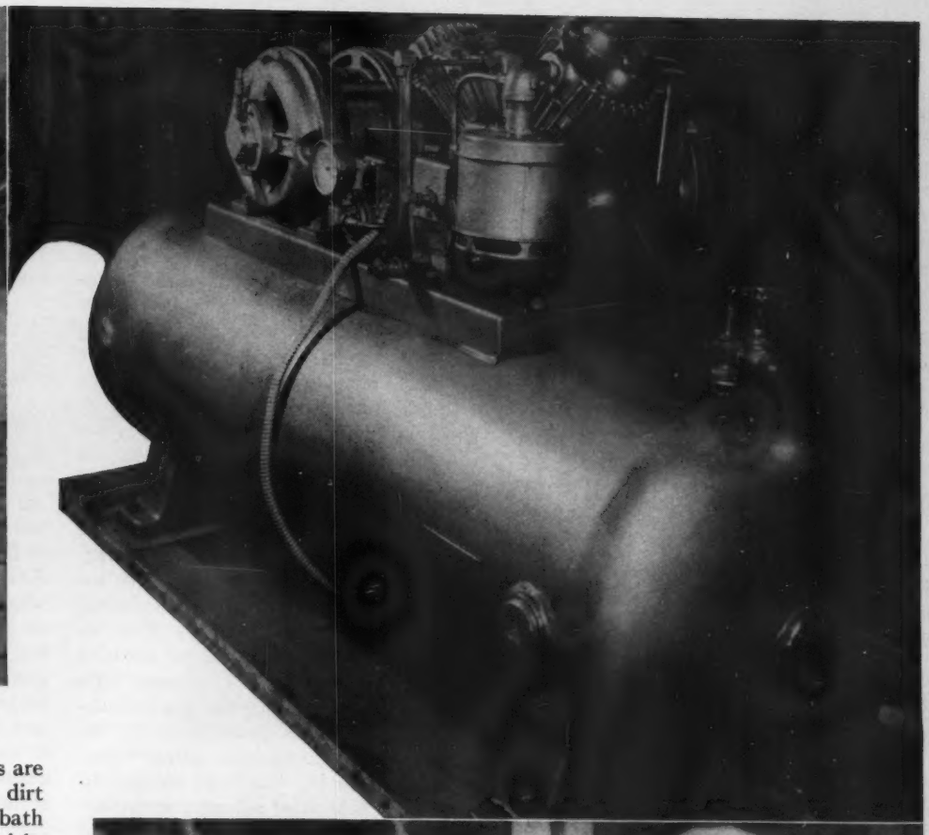
What might be termed the aristocrat of pressure tubing is that supplied for injecting fuel oil into diesel-engine cylinders. If the engine is to function properly, the fuel oil—usually but a drop—must be vaporized and injected in as little as three- or four-thousandths of a second. To accomplish this, fuel-injection pumps operate at pressures up to 9,000 pounds per square inch and at speeds that impose on the injector line pulsations up to 5,000 per minute. This obviously calls for tubing that will withstand extremely severe service and that has a uniform, smooth bore. At the same time it must be ductile enough to permit easy bending and cold upsetting of the ends to facilitate its assembly into operating units. In collaboration with leading builders of fuel-injector systems, Summerill has developed methods of making tubing that answers these requirements. The high pressures call for tubing of relatively heavy walls, and the high velocities for small bores. Standard sizes have outside diameters ranging from ¼ to ⅝ inch and inside diameters from 0.058 to 0.216 inch.

In the field of small tubing, one of the specialties is sleeves or cathodes for radio tubes of the so-called heater type that made their appearance when alternating-current sets were developed. These cathodes receive heat by radiation from the tube filament, which is not connected directly into the electrical circuit as was the case with battery-operated sets. To give them the desired properties, they are made of 99.5 per cent pure metallurgical nickel. They range in size from 0.016 inch to 0.1 inch in outside diameter, with a wall thickness from 0.0015 to 0.007 inch. Larger sizes of nickel tubing are used in Neon lights, high-intensity industrial lights, and X-ray tubes.

From the foregoing review of the principal Summerill products it might be inferred that some sort of black magic is resorted to in their making. Actually, there is nothing mysterious or complicated in the manufacturing process; but it does demand precision and exacting attention to detail.

Summerill does not make steel, nor does it even make the tubes in the first place. It merely finishes or refines them. The tubes with which it starts are pierced and hot-rolled at the mill which supplies them, whereas, as already stated, all the subsequent reducing operations are performed while they are in the cold state. As is well known, such cold-working imparts desirable physical characteristics to the metal.

The hot-rolled tubes or billets, as they are termed, are received in 10- to 20-foot lengths, and with diameters materially larger than those to which they will ultimately be finished. Before it can begin its journey through the drawing dies, each piece must be reduced in size, or pointed, at one end. This is done by swaging it in an air-operated drop forging hammer in the case of the larger sections and in a belt-driven rotary-type hammer in the case of smaller ones. The size and composition of the material determines whether it is to be hammered while hot or cold.



USES OF COMPRESSED AIR

Compressed air is used at various stages in the drawing process to remove scale and dirt from the inside of the tubing. The top-left view shows an operator blowing out diesel-fuel-injection tubing after it has been shaped and fitted as specified by the customer. Small tubing is also tested for leakage by introducing air into its two ends simultaneously while the rest of it is immersed in a basin of soapy water. At the bottom is seen a die-annealing furnace with an air-operated door. General plant air is supplied by two duplicate Ingersoll-Rand air-cooled compressors, one of which is illustrated at the top-right.

Prior to drawing, the pointed billets are pickled in sulphuric acid to remove dirt and scale, inhibitors being used in the bath to prevent pitting of the metal. The pickling is followed by rinsing in water, after which the tubes are immersed in a lubricating compound to lessen friction in passing through the dies.

Thus prepared, the tube is ready for drawing. This is done on a horizontal machine called a draw bench, which is illustrated. To reduce both the outside and inside diameters simultaneously, the tube is drawn through a die and over a mandrel. The die is held in what is known as a die head. The pointed end of the tube is inserted through this and gripped by the serrated jaws of a wheel-mounted truck, called pliers, that runs on rails. Beneath the pliers is an endless sprocket chain that is driven by an electric motor. When a hook on the pliers engages this chain and power is applied, the drawing starts. The mandrel is a round piece of hardened and polished tool steel. It is attached to one end of a rod the other end of which is anchored by means of a screw nut at the back end of the bench. The length of this rod is adjusted so that when it is inserted in the tube the mandrel is in the same vertical plane as the working face of the die, in which position it is held immovable.

The mandrel or plug is of a size that will just comfortably fit within the tube. It is obvious that its diameter controls the bore of the tube being drawn, while the die controls the outside diameter, and the space between the two determines the wall thickness. In drawing it, the metal, although cold, is made actually to flow, with the result that the thinning of the wall section adds length to the tube. The amount of

reduction possible in one pass depends upon the composition of the metal and other factors. In some cases it amounts to as much as 35 to 50 per cent of the area of the tube-wall cross section. The reduction in outside diameter is relatively small, however, and to make a small tube from a large billet it is therefore necessary to repeat the drawing process many times with progressively smaller dies and mandrels. As there is a limit to the smallness to which tube billets can be rolled by the hot process, the number of "passes" required to produce very small tubing sometimes reaches 50.

As cold-working hardens the metal, the tubes have to be annealed between passes to restore ductility. Two types of annealing furnaces are used. The older types are coal-fired. Their drawback is that they permit oxidation and the formation of scale, even though these tendencies are lessened in the case of small tubing by placing it inside large pipes and sealing the ends to exclude oxygen. Even so, it is necessary to clean the surfaces by pickling between drawing operations, and this not only increases the time and cost of processing but also results in a considerable loss of metal, in the aggregate.

The newer furnaces are continuous-type, nonoxidizing, electric-fired units with full automatic heat control. An inert atmosphere is maintained inside by introducing gas obtained by cracking illuminating gas or ammonia gas. The material is conveyed through the furnace at any desired speed, and, before emerging, is cooled to almost room temperature in a chamber through the walls of which cold water is circulated. Certain products, including all aircraft tubing and most of the very small tubing, are turned out with a bright oxide-free surface by the use of these furnaces.

In general, the production of a tube, large or small, consists of repeating the drawing and accessory operations until the desired size is obtained. As it normally takes from 36 to 48 hours to complete a full drawing cycle or pass, some tubes may be in process of manufacture for two or three months. Regardless of their ultimate shape, tubes are first made round, after which they are finished to the desired section by passing them through dies of the appropriate form.

The equipment used varies in minor respects from that described, depending upon the requirements of the product being made. For example, the mandrel is sometimes a polished steel rod that passes through the die with the tube being drawn. This necessitates a subsequent operation to expand the tube slightly so that the mandrel may be withdrawn. It is interesting to note that piano wire serves as a mandrel for some of the smaller tubes. In the very small sizes, with almost microscopic bores, the final passes are made with no supporting mandrel. In some cases, notably in finishing steel magazines for repeating shotguns, the tube is pushed through the die instead of drawn through it.

Mention was previously made of the lengthening of a tube with each drawing. When, after several passes, the length becomes too great for convenient handling, the tube is cut into several pieces. The cutting is done with thin, high-speed abrasive wheels. As it is necessary to point each piece prior to further drawing, the cumulative loss of tubing is considerable by the time a billet is reduced to its ultimate size. After needle tubing has been reduced to small size, it is handled in longer sections—moves through the plant in the form of coils. Subsequent drawing is done on rotary machines, or bull-blocks. There the tubing is carried on a vertical reel, from which it unwinds as it passes through the die. It is gripped by tongs on another reel, which is rotated to draw the tubing through the die, after which it is coiled on this second reel.

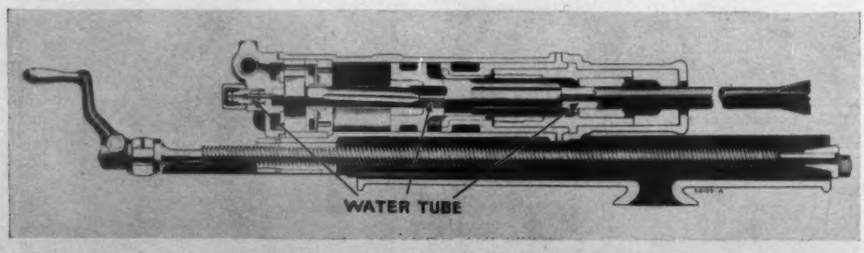
Dies and mandrels are of such importance in the production of tubing of accurate size and smooth finish that special attention is given them. It will be appreciated that a large stock of these must be maintained. The larger dies are of high-grade tool steel or tungsten carbide. All the former are made in the company's machine shops. Diamond dies are used for drawing the smaller sizes of tubing.

Special forms of tubing not covered in the foregoing can only be briefly mentioned in an article of this length. Among these is laminated tubing, which has walls composed of consecutive layers of two or more different metals. Such a tube may have a copper lining to resist corrosion, and an exterior wall of steel for strength. It is made by placing a copper tube within a steel one and drawing the two as a unit. Although the resulting bond between the metals is only of a mechanical nature, it is a very close one. Another specialty is graduated tubing, in which outside and inside diameters and wall thickness are all decreased progressively section by section the length of the tube.

The finishing operations vary according to the nature of the product and the specifications to which it is made. The final drawing operation leaves it bright and smooth, but hard and brittle. It may be shipped in this condition, or it may be annealed at different temperatures, depending upon what further operations will be performed on it by the purchaser. After final processing, all tubing is straightened, cut to length, and inspected for defects. If it is intended for pressure service, it is given a hydrostatic test, equipment being available to subject it to pressures up to 3,500 pounds per square inch. Every piece of aircraft tubing is checked for physical properties by taking hardness readings on a Rockwell machine.

It is obvious that with tubing of many compositions going through the mill, great care must be taken to see to it that each lot receives the exact treatment specified. To this end, each billet is given an identifying number at the outset, and all tubing made from it carries that number throughout the processing operations. A file is kept of the requirements of all customers as to tolerance, finish, physical properties, etc., and every order received is checked against this record before production starts.

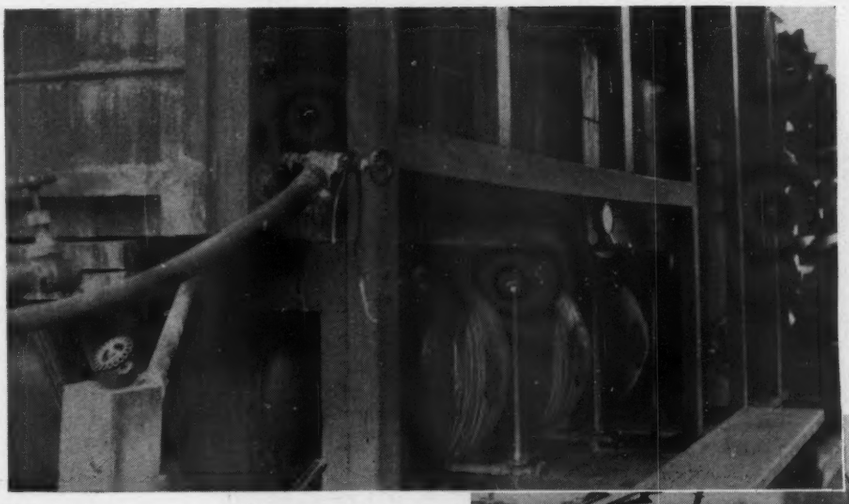
Compressed air is not used in great volume in making tubing, but its services are nevertheless important. At the first drawing bench, where the initial drawing of large-size tubing is done, an air-actuated plunger automatically pushes the tube billet over the mandrel and the rod to which the latter is attached preparatory to inserting the pointed end in the die. As tubing progresses through the plant it must be periodically cleaned inside, and this is accomplished by blowing a blast of air through it from jets that are provided at the various working stations. Small tubing is tested with air pressure. First, air is applied to one end and the other is placed in a basin of soapy water. The formation of bubbles shows that the bore is clear. Then air is introduced into both ends while the rest of the tube is immersed in water to test it for leakage. Compressed air for these and miscellaneous other purposes is supplied by two duplicate Ingersoll-Rand Type 30, air-cooled compressors. They are equipped with automatic stop-and-start control and discharge at 80 pounds pressure.



WHERE GOOD TUBING IS DEMANDED

In wet-type rock drills, water is directed through the drill and thence through the hollow drill steel to the bottom of the hole, from which it washes away cuttings. This sectional drawing of an Ingersoll-Rand drifter drill shows the water tube passing through the rifle bar and piston and entering the drill-steel shank. This tube is subjected to severe service, particularly if the hole in the drill-steel shank is not opened to its original round section each time it is reconditioned in the blacksmith shop. So that failures of this essential drill part may be kept as low as possible, Ingersoll-Rand employs seamless tubing made of chrome-molybdenum steel and exercises great care in shaping and hardening it.

Driving Chemical Through Piles



THE PROCESS AT WORK

Immediately above are shown the washtub-like caps fitted over the ends of logs that are being treated with chemical. The upper view shows the vat in which the liquid is prepared and, beneath it, the tanks from which it is forced to and into the logs by the application of eight pounds of air pressure. The treatment protects piles against attacks by termites and marine borers, increases their strength, and makes them resistant to fire. The chemical is forced into the wood slowly, so as not to damage its internal structure. About eleven days are required to impregnate a 100-foot pile from end to end. For successful treatment, the timber must be green and still retain its sap. Injection is usually made within a week after trees are cut. The entire plant is portable and can be set up convenient to the timber supply.

AT FIRST thought, to drive a chemical solution through a 100-foot pile, from end to end, using no more than eight pounds per square inch of air pressure, seems extraordinary. Yet, that is being done by a new system of pile and pole treatment of the Mineralized-Cell Wood Treatment Company of Seattle, Wash. However, when one stops to think of it, Nature, by capillary attraction alone, does the same thing against a vertical lift. As the poles and piles are laid out horizontally during their treatment, it is not so surprising after all that eight pounds of pressure does the job very well.

The treatment amounts to giving the piles an "intravenous shot" of medicine, which drives the sap out of the cells and saturates the latter with the chemical compound. By applying the chemical in this way, under constant, moderate pressure, the cell structure of the wood is not broken down.

The company previously mentioned has patented the essential features of the system and also operates it on a contract basis. The contracts include the furnishing of the timber and the treating of it in compliance with the specifications set forth by the purchasers. The process is practicable only with green timber which has the sap still in it and has preferably been cut within a week previous to treatment. Therefore, one of the plants of the company has been made portable, and is now being operated in Portland, Ore. It can be set up anywhere convenient to a timber supply and has been operated in a number of places.

Both the process and the equipment are simple. Caps are made of rubberized fabric of the kind used in automobile-tire casings. After they are cut out, fitted and vulcanized, they strongly resemble ordinary metal washtubs. A short piece of hose, with a coupling at the outer end, is vulcanized into the closed end of the cap to provide a means for introducing the chemical.

A cap is fitted over the butt of a pole or pile, which has first been peeled down with a draw knife to approximately circular form, but without cutting into the sapwood. The cap is then brought up to a tight fit with wire rope and clamps acting like hoops. As a further measure to prevent its blowing off the end of the pile, the cap is secured with chains rigged over the end as illustrated.

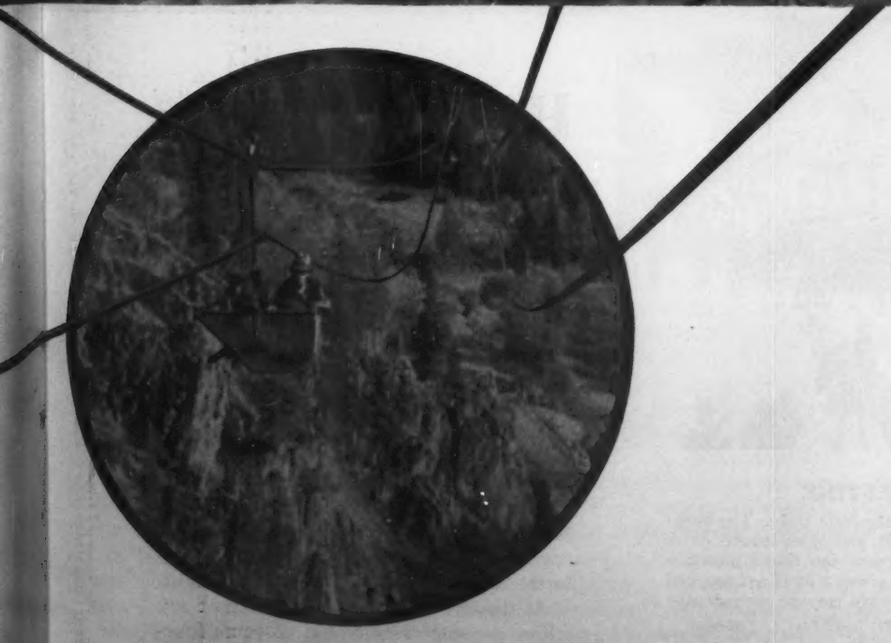
All that is then necessary is to connect the hose carrying the chemical, and the air pressure forces the fluid clear through the pile. It takes approximately 11 days to impregnate a 100-foot pile from end to end. Sometimes, poles are merely butt treated for a short distance. It all depends upon the specifications for each job. To ascertain when the impregnation is sufficient, test borings are made from time to time. The specifications usually call for a certain percentage of chemical to the cubic foot of wood.

The small plant can be packed up and trucked away on short notice when a job is completed. The chemicals are mixed in an elevated wooden vat, provided with a simple mechanical agitator. The mixing requires half an hour at boiling temperature, and a small, wood-burning vertical boiler provides the heat.

After mixing, the liquid is drained into four horizontal compression tanks below the vat. Two of these hold 80 gallons, and two hold 60 gallons. Air pressure is then applied on top of the liquid in the tanks. The eight pounds is sufficient to force the liquid through hundreds of feet of hose into the individual caps and thence clear through the piles. It is surprising to note that the compressor required for the purpose has a capacity of only 2 cfm. of free air and that only a ⅓-hp. motor is needed to operate it.

The rubber caps are made in five sizes, up to 21 inches in diameter. One as small as 3 inches has been made for treating peavey handles. One of the principal purposes is to protect the wood against termites and also marine borers. The base of the chemical solution is arsenic, which is especially effective against termites, but it also contains eleven other chemicals. The effect is to metallize the wood. This not only keeps out ants and borers, but also acts as a preservative, as a hardener that is helpful in driving the piles, makes the wood highly fire resistant and, finally, increases the cross-breaking strength 20 per cent by actual test.

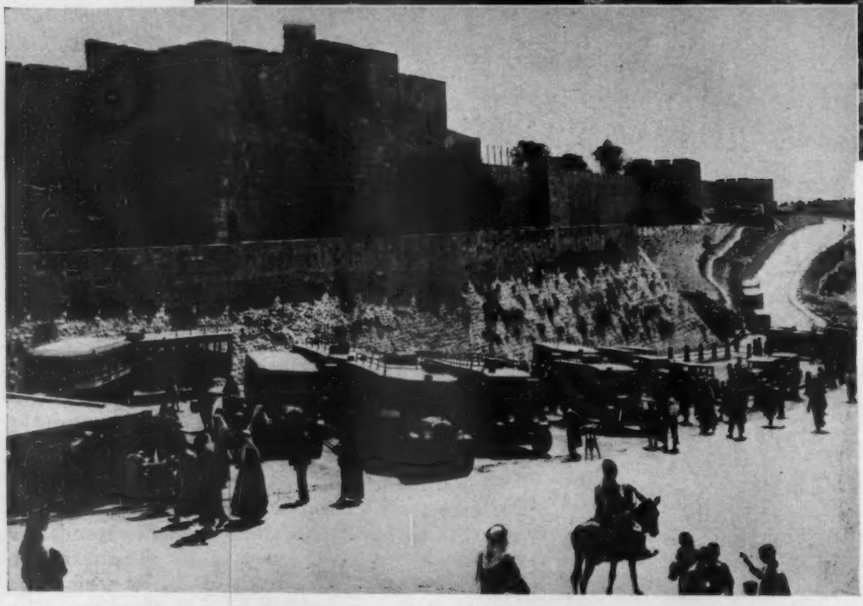
For the operation of the plant, a level and spacious site is chosen, and there the logs are yarded parallel and close to each other in long rows. This is done by means of a Caterpillar diesel RD-4 tractor. Half a dozen men can run the plant: one for the mixing end, one for the tractor and the others to shave the butts, apply the caps and remove them when the process is completed.



A CLOUDLAND RAILWAY

MANY high-altitude mines rely upon aerial tramways for the transportation of all ore, supplies, and workmen. Such systems operate effectively regardless of weather conditions, are economical, and, though their appearance may belie it, are exceptionally safe. These pictures show the Shenandoah-Dives Mine near Silverton, Colo., and the tramway that serves it.

The main tram runs from the mill, at elevation 9,680, to an ore-loading station 120 feet below the mine. From there an auxiliary system extends 400 feet to the mine, at elevation 11,200. The total rise is thus 1,520 feet. The track cable, on which the ¾-ton buckets run, is 1¼ inches in diameter. The traction cable that pulls the buckets along is ⅞ inch. The main towers are of fabricated steel. The picture at the left was taken from the mill. The mine buildings appear small near the base of the cliff in line with the tramway's path through the timber. The circle shows a passenger in one of the skyway Pullmans.



THE OLD AND THE NEW IN PALESTINE

Immediately above is a part of the old wall of Jerusalem, at the Jaffa Gate. The burro in the foreground and the buses that run to Bethlehem, Jaffa, and other nearby cities offer a striking contrast in transportation facilities. The upper view shows a section of Haifa, with the bay in the distance. Most of the buildings are new and have marked similarity to modern German architecture. At the water's edge may be seen storage tanks for petroleum that is run by pipe line from the rich Iraq oil field.

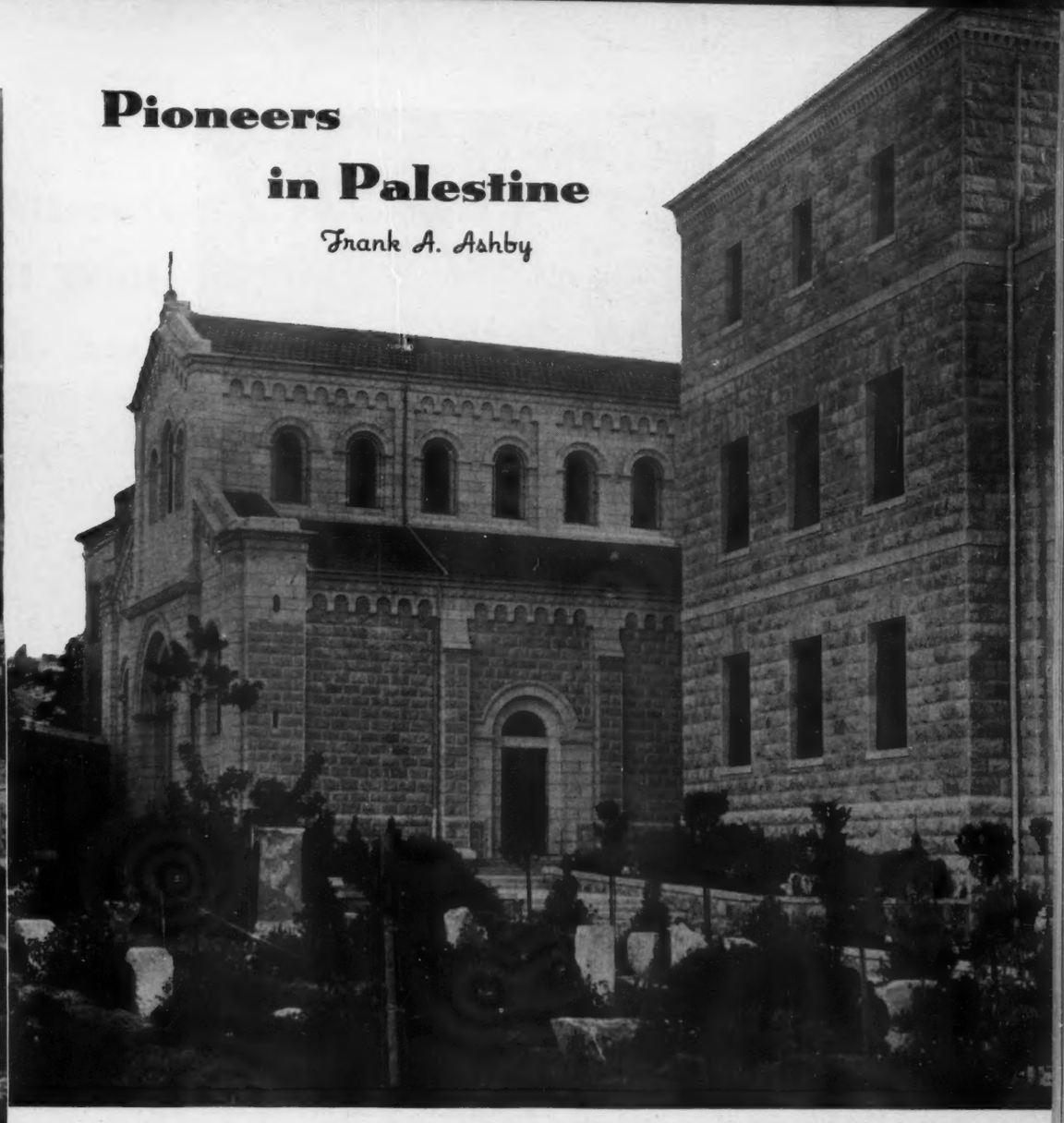
HISTORIC Palestine, which is today undergoing a transformation that is revolutionary in its character, is the next objective of that party of vicarious travelers that accompanied me on my business trip in Turkey, as described in the August, 1937, issue of this MAGAZINE. At the conclusion of that journey I left Istanbul by boat, which threaded its course out of the harbor through a maze of shipping ranging from strange sailing craft to ocean greyhounds from many lands. Standing in the stern of the 5,000-ton steamer, which is small as such vessels go, I watched the sun go down in a blaze of glory that made the wash of the propeller appear like molten gold. Slowly the minarets and towers of the city faded from view, disappearing in the deep blue that characterizes the sky in the Far East at twilight.

At dinner that night I found that my fellow passengers consisted of some four-

Pioneers in Palestine

Frank A. Ashby

Fox Photos, Ltd.



ST. JOSEPH'S CHURCH, NAZARETH

teen Turks and Arabs, businessmen who spoke in tongues unfamiliar to me, making me feel a little out of place. But, with the spirit of comradeship generally prevailing on shipboard, it was not long before they discovered my predicament and began to converse in English, which most of them talked fluently. Throughout the rest of the voyage they went out of their way to make me feel at ease and to point out the many places of interest that were to be seen *en route*.

Crossing the Sea of Marmara, we entered the Dardanelles the following evening. Gallipoli, which played such a memorable part during the World War, stood out like a sentinel, dark and forbidding; but twinkling lights penetrated the gloom and betokened a place where people lived and worked much as they do elsewhere the world over. On the boat went past the French and English cemeteries with row upon row of well-kept graves where lay the soldiers that had so valiantly fought and died there for those nations. Fitting monuments towered above them here and there—all silent and grim reminders of the horrors of armed strife.

Soon we were out on the broad and smiling bosom of the Mediterranean, threading our way between numerous islands with white wave-washed shores. Leaving Cyprus the largest of them in our wake, we made for Beirut in Syria. Many stories could be written about this port alone. Here again were ships from the far-flung corners of the globe—natives diving for money in the clear, blue waters—traders swarming aboard and converting the boat deck into a bazaar with colorful wares and trinkets—last-minute bargaining—all bustle and confusion getting the natives off the vessel ready for its run down to Palestine, the Holy Land, my destination. The prospect was a thrilling one, and the passengers lined the rails to get the first glimpse of the region that until late years had remained much as it was during Biblical times. Approaching the Port of Haifa, I saw gleaming white against the sky what appeared to be towers. Upon inquiry I was told that they were oil storage tanks for the Iraq pipe line, that feat of engineering and endurance. Behind them loomed Mount Carmel.

Upon disembarking, I was met by F. C. Rendle, chairman of The Engineering Corporation of Palestine under the guidance of which I was to make a tour of inspection of the roads that have been built around Haifa since the Jewish people began their great influx into Palestine. Faced with a housing shortage, it was necessary first of all to provide adequate living accommodations for the immigrants; and as homes and apartment houses were constructed and as the city spread, the next step in the program of modernization was

PAVING A HAIFA STREET

Because of the narrowness and steepness of some of the streets, it is impossible to use rollers for consolidating macadam pavements. Accordingly, the municipal engineers resort to air-operated CA-35 paving breakers equipped with tamping pads, and these do the work satisfactorily.

ROADBUILDING

As an accompaniment to the rapid growth of Haifa, more than 55 miles of new streets and roads have been constructed in and around the city since 1933. Practically all this work has been done by Jewish immigrants, who have become proficient in it despite the fact that most of them were previously engaged only in sedentary occupations. The pictures show a road under construction and a stretch of finished highway.

that of improving the highway system linking the port with other important points in the country.

Since 1933 there have been built 56½ miles of roads, and more are in course of construction. As the work has involved the removal of large quantities of rock, and as the element of time has been an important factor, many portable compressors and air-driven drills have been used to expedite it. In fact, 85 per cent of the roadbuilding has been done with the aid of portables driven by Hesselman oil engines, because units of this type are light in weight and therefore easy to move about in mountainous regions. The compressors, I found, had been well looked after. Most of them had been in continuous service since 1934, operating eight hours a day with only a valve-grinding job once a year. A completely equipped machine shop is maintained where every kind of overhauling job in connection with the highway work can be taken care of.

With the inspection completed, we left Haifa and proceeded over one of the fine new roads to Jaffa, passing on our way through Nazareth. Arabs on sprightly horses galloped by us, cultivated lands stretched out on either side, and on the hills shepherds tended their flocks as of old. Thence on to Tel Aviv, which for up-to-dateness would compare favorably with any town of equal size in the United States. Here, too, the work of transformation has been facilitated by portable compressors equipped with Hesselman oil engines, and air-operated Jackhamers and paving breakers have helped to lay the foundation of that great community of which the builders are justly proud.

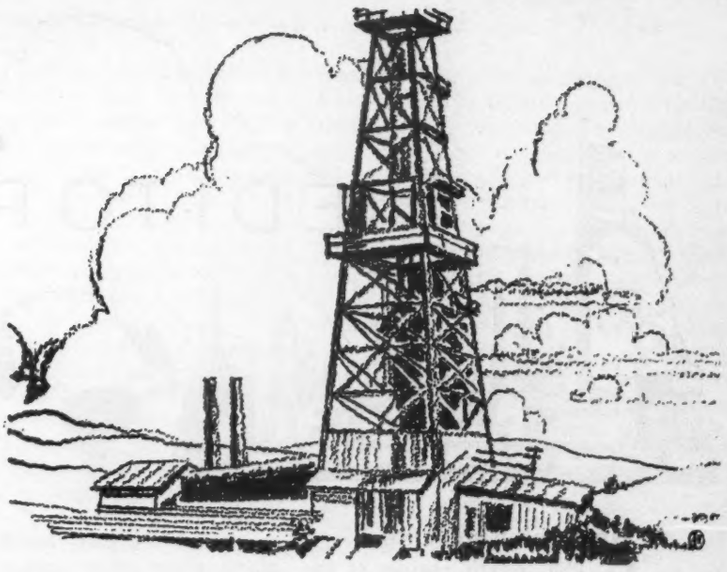
Jerusalem was our next objective. On our way to the sacred city we saw numerous orange groves, and I was told that out here, when the Jewish people wish to honor a particular person, they do not erect a monument in commemoration but plant an orange grove instead. In this they have certainly struck a sensible note, for such a memorial, besides being entirely fitting, not only gives employment but can also be made to pay for itself and to yield a profit, besides.

In Jerusalem, as elsewhere in the Holy Land today, one is struck by the great contrasts that are to be met at every turn. Picture, for example, a modern office. On one side of the desk the business manager, as we know him: on the other an Arab sheik of splendid bearing, well over six feet tall, dressed in flowing white robes, turban, and sandals, and with a gold-handled knife thrust in his belt. They were talking in Arabic as I came upon the scene, and it interested me to learn subsequently that their topic of conversation was far from what one would commonly associate with so colorful a figure. It should be mentioned that the Arabs now grind their corn exclusively by machinery; and the chieftain was inquiring about his engine and whether or not it needed new piston rings.

Much construction work is going on in Jerusalem, and outstanding among the building projects is a hospital situated near a large college on a hill overlooking the city. When completed it will be one of the most modern institutions of its kind, and will open its doors to all comers. Traveling from place to place, one becomes conscious of the fact that Palestine is in the process of becoming an entirely new country; and it should be borne in mind that the people that have taken upon themselves the enormous task of remaking it are more or less pioneers in the sort of work that it takes to do this. Merchants and professional men—lawyers, doctors, writers—have turned contractors, builders, farmers, and, what is more, have done so with conspicuous success, as evidenced by what has already been accomplished.

Loading Nitroglycerin in Oil Wells with Air Under Pressure

F. R. Cozzens



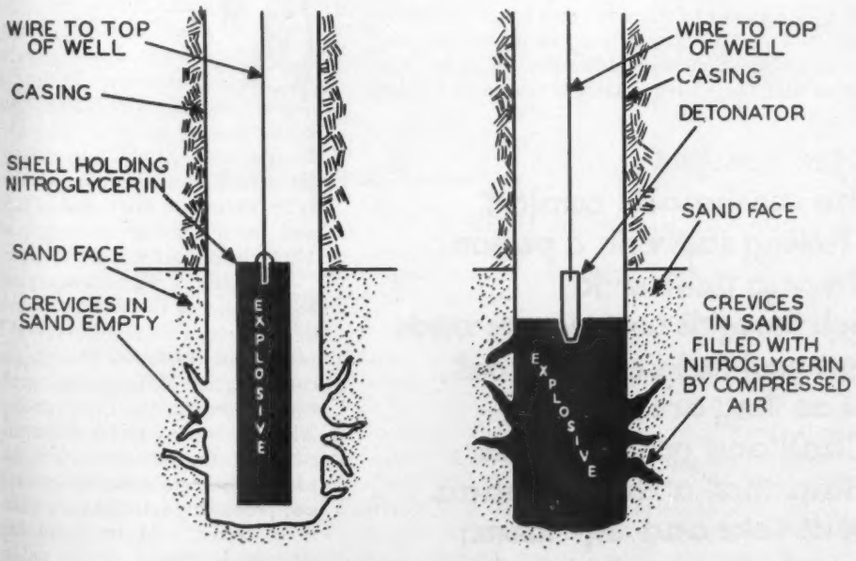
ONE of the most recent applications of compressed air in oil-field operations is that of loading nitroglycerin charges in newly drilled wells. The general practice has been to confine the explosive in a metal tube or torpedo shell which is lowered to the bottom of such a well, the length of the shell and amount of the explosive used being determined by the thickness of the sand. This method involves considerable guesswork when it comes to placing the shell; and the force of the blast has to be controlled entirely by the quantity of earth, known as the anchor, which is poured down on top of it.

Inasmuch as the purpose of the shot is to burn residue from the sand face and to open up channels through which the oil can drain into the well, it can be readily understood that better results would be obtained if the explosive were distributed, so far as possible, among the numerous small crevices in the sand. Such distribution requires pressure, and oil-field workers are now generally agreed that the most efficient form consistent with safety is air pressure.

When a newly drilled well is to be brought into production, the modern operator lowers the necessary amount of nitroglycerin through the casing in a metal tube with a trapdoor in the bottom. Immediately upon reaching the desired position in the sand, the trapdoor opens automatically, and the explosive drains out. After the empty shell has been withdrawn, a reducing nipple is placed in the casing head and air is forced down the well from a gas-engine-driven compressor. Such stationary units, usually of V-type construction, are standard equipment in most oil fields. If such equipment is not available, a portable compressor capable of delivering air at 1,000 pounds pressure or more is brought on the job. Regardless of the type, the machine is kept going until the pressure in the well registers 500 pounds or more at the casing head. At this point the compressor is stopped, and the accumulated pressure is suddenly released through a valve in the casing. The operator then drops a detonator connected to a length of copper wire, lifts the casing, and the charge is fired by means of a blasting battery.

The use of air has no visible effect on the upward force of the blast; but there is an immediate heavy inpouring of sand and residue at the bottom of the well, showing that the pressure has pushed the explosive back into the channels in the sand. This results in better breakage and, consequently, in more and larger channels through which the oil can drain into the well.

Ordinary nitroglycerin shots, it has been estimated, increase the natural flow three times, while it is no uncommon thing for explosive charges loaded with air under pressure to increase the flow fourfold. In southern Ohio wells, previously shot by the old method, an increase in production of 60 per cent was obtained when a secondary blast was applied by means of compressed air. In all cases air pressure resulted in larger reservoirs, as well as in a saving in explosives averaging $30 per well. With air under pressure, it is now possible to direct the blasting force against any part of the oil sand and, by the length of time pressure is applied, to control the injection of the liquid explosive into the sand channels. The new method can be readily adapted to meet loading conditions in any locality.



OLD AND NEW METHODS COMPARED

The sketch at the left illustrates the conditions at the bottom of a well when nitroglycerin is fired while still confined in the container in which it is lowered. The explosive naturally cannot exert its maximum effect in opening channels in the oil-bearing formation. When the nitroglycerin is emptied from the shell and air pressure is applied to it, it is forced into the openings in the rock, as shown at the right. Better breakage is the result.

MINES OF PALESTINE

IN THE eighth chapter of the Book of Deuteronomy, the Promised Land of the Israelites is described as one "whose stones are iron, and out of whose hills thou mayest dig copper." The verity of that Biblical passage has for a long time been doubted, but recent investigations in the Holy Land conducted by Dr. Nelson Glueck, director of the American School of Oriental Research, have fully substantiated it.

Doctor Glueck's party explored the 115-mile stretch of desert waste that extends from the Dead Sea southward to the Gulf of Aqabah, and found many surprising things. This region of 'Arabah, as it is known, is devoid of settlements and human beings, but there is unmistakable evidence that it once teemed with mining and metallurgical activity.

About 20 miles south of the Dead Sea the expedition discovered the ruins of a hitherto unknown fortress, situated on top of a hill and not far from a spring. Fragments of pottery unearthed fixed its age as that of the time of the kings of Israel and Judah. The size of the fortress indicated that it must have been well garrisoned, but the reason for its existence there was not immediately apparent. Further investigation revealed, however, that it commanded the roads leading to several one-time important mining and smelting sites. The pottery was identified as relating to the period between the twelfth and eighth centuries, B.C., during which King Solomon reigned.

The sites are walled enclosures or compounds, which probably served the dual purpose of repelling invaders and imprisoning the slave workers. Inside are the ruins of large buildings, workers' huts, smelting furnaces, and great heaps of copper slag. Continuing southward, the party found other similar places where either copper or iron had been mined and smelted.

As there is virtually no water in the 'Arabah, and as temperatures are unbearably high in summer, operations were undoubtedly carried on only during the rainy season of winter and early spring. No fuel is available nearby, and it is probable that it was imported on the backs of donkeys and camels in the form of charcoal from the heavily wooded hills of western Edom.

It is now believed that these workings were the sources of the copper used by King Solomon in the building of his temple and palace in Jerusalem. It is likely, also, that the rich cargoes of gold, silver, ivory, perfumes, and rare woods which the Bible records his ships brought back from Ophir were obtained in exchange for copper and iron from the 'Arabah.

Samples of ores taken by Doctor Glueck showed a copper content ranging as high as 7.36 to 10.3 per cent, and others held as much as 63.2 per cent of iron. A piece of slag contained 2.73 per cent of iron, showing that the reduction process was far from perfect. As the extent of the deposits is unknown, and because of the physical and economic obstacles that would attend their exploitation, Doctor Glueck would not venture an opinion as to the possibilities of establishing profitable enterprises there now.

Yuletide Soliloquy

THE following tribute to friendship seems appropriate at a season when we all turn a bit sentimental and shower tokens and greetings upon those who are closest to us. It was lettered and sent to us by Charles Grayson of Troy, N. Y., who first saw it on a card displayed in a shop window in Milwaukee, Wis., in 1920. He states that the author's name is unknown to him.

Oh the comfort,
The inestimable comfort
Of feeling safe with a person;
Having neither to
Weigh thoughts nor measure words
But pour them all right out,
Just as they are,
Chaff and grain together;
Certain that a faithful hand
Will take and sift them,
Keep what is worth keeping
And, with the breath of kindness,
Blow the rest away.

NICKEL TO THE FORE

REVERSING the trend shown by most base metals, nickel actually increased in use during the depression years, and is still showing a healthy growth. Canada, from which most of the world supply of nickel comes, produced nearly 85,000 tons of this metal in 1936 and, for the first seven months of 1937, the output was 63,500 tons.

The Sudbury deposits now yield 88 per cent of the world's nickel, 49 per cent of its platinum, and 8 per cent of its copper. Despite the concentration of its mining operations, however, the International Nickel Company seems well named, for it not only supplies nickel to the whole globe but its refining and processing activities are widely scattered. Matte from the smelters is treated at two points in Canada, at Huntington, W. Va., and at Clydach, Wales. Platinum and gold are produced at Acton, England, from metal residue shipped there from the Sudbury region.

Curtain of Air Screens Locomotive-Cab Lookout

ABOUT a hundred locomotives of the French Railways are provided with a windowless lookout that gives the engineer an unobstructed view straight ahead. The unusual feature of this lookout is the curtain of air with which it is screened to protect the driver against wind-borne cinders, hail stones, and other solid matter. The Pottier apparatus, as it is called, was introduced about three years ago, and has proved so satisfactory that its use is to be greatly extended—the express trains of the Compagnie du Nord, among others, are to be equipped with it.

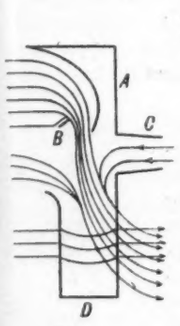


FIG. 1.

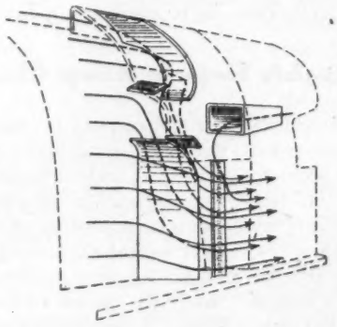


FIG. 2.

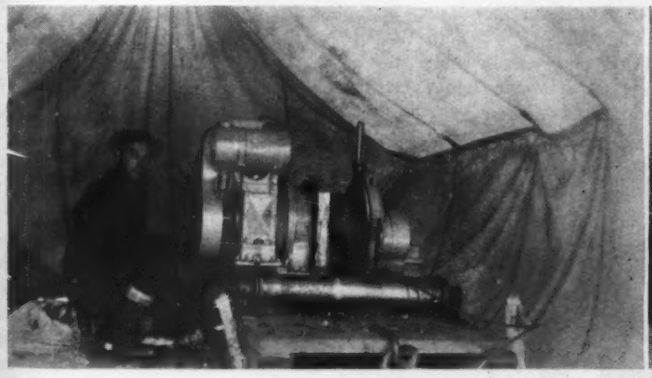
The device is so designed that the wind blowing against the lookout aperture is deflected, together with the particles carried by it in suspension, by a stronger blast of air. The principle upon which the system is based has been explained as follows in *The Engineer*, through the courtesy of which the accompanying drawings are reproduced.

As shown in Fig. 1, the wind entering the upper part, *A*, of the apparatus makes a parabolic curve, at the bottom of which it is throttled by a baffle, *B*. At this point the current descends at high velocity across the lookout aperture and the wind entering below the baffle is deflected downward and serves to increase the velocity. At the same time the depression caused by the current induces a flow of air through the lookout tube *C*, which is of truncated pyramidal form. This horizontal current adds about 10 per cent to the velocity of the vertical current.

At *D*, in the lower part of the device, are two slots from each of which the material is bent back to form a shoulder. In passing over these shoulders, the wind creates depressions which further increase the velocity of the combined currents flowing down through the slots. The cumulative effect of pressure and depression is to give to the air screen across the lookout sufficient velocity to resist anything that may be blown against it by the wind. Any variation in wind pressure has no effect upon the air screen, as the relation between the velocity of the wind and of the air current passing through the apparatus is constant. No trouble has been experienced with moisture carried by the air currents in wet weather, although it was at first believed that it would condense in the lookout tube. To guard against this, the opening was originally provided with a hinged glass cover with which it could be closed partway. However, this was found to be an unnecessary precaution.

In Fig. 2 are shown the structural features of the Pottier apparatus: the upper deflection plate, the baffle, the lookout tube, and one of the side slots. Obviously, the field of vision provided is smaller than under ordinary circumstances, but it is said to be ample for all the engineer's needs. Signals are visible until he is alongside them, and he always has a clear view ahead.

Hoist Replaces Horses for Hauling Logging Sleigh



A MECHANICAL AID FOR LOGGERS

At the left is the small hoist installed in a tent. Being skid-mounted, it can be moved easily and quickly. The right-hand picture shows a logging sleigh being drawn up the steep hillside. The operation of this equipment costs only a few cents a day, as compared with $5 for a team of horses. Such a hoist can be used to do many moving jobs.

NEW applications of small, portable, drum-type hoists are continually being made, and among recent ones is that illustrated in the accompanying pictures. In this instance, a hoist is being used to draw empty logging sleighs up a steep slope during winter operations of the Canadian International Paper Company, Ltd., at Miller Creek Camp in the Province of Quebec, Canada.

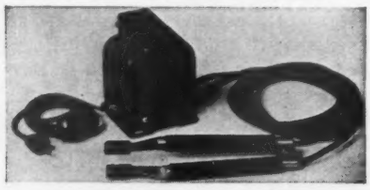
The sleighs are hauled a distance of 250 feet up a grade that is nowhere lower than 30 per cent and that reaches 40 per cent in two places. During the morning, when the snow is hard, the pull is made with a single cable; but later, when the snow has softened the ground surface, a block is employed.

The hoist is an Ingersoll-Rand single-drum Tugger driven by a gasoline engine and having a rated lifting capacity of 1,500 pounds at a cable speed of 125 feet per minute. During the past weeks it handled sleighs weighing 3,000 pounds each. The haul up the hill took 2½ minutes and was made about 30 times a day. The cost of operation was negligible, the engine requiring only 1 gallon of gasoline daily and about 2 quarts of lubricating oil a week. The hoist is mounted on a skid and can be easily moved—being capable of drawing itself along, where necessary, by making the cable fast to a tree or rock. Previously this heavy hauling was done with a team of horses at a cost of $5 a day.

The success of the hoist in this case has suggested that there may be a wider field of application for it in isolated sections. Among other work, it could possibly be used for handling rock on road and stream-improvement projects, for loading gravel into trucks on highway jobs, for moving compressors and other machinery, and for doing miscellaneous hauling. This hoist is available in several sizes.

Soldering Iron for Small and Close-Quarter Work

IN ANSWER to the increasing demand for a small, low-capacity soldering unit that will sweat joints without unsweating adjacent connections and that will eliminate the open-flame hazard, the Ideal Commutator Dresser Company has added to its line of thermogrip electric pliers what is known as No. 2 Midget. This tool has been designed especially for work on small objects and in restricted spaces such as switch and fuse boxes. There are many applications for it in the electrical field, in the making of radios, in plumbing, in refrigeration, etc. For example, it is suitable for soldering small lugs and terminals up to 150 amperes on switchboards, motors, and generators, and for sweating joints on copper pipe and tubing having a diameter of not more than ⅜ inch.



The Midget consists of pliers and of a transformer with the necessary electric leads and connection. The pliers have long, slender jaws of cast bronze with a protective fiber covering. They are hinged at the end instead of in the middle to facilitate handling, and are provided with a spring that holds them open when the tool is not in use. The transformer is conservatively rated at 160 watts continuous duty or at 300 watts intermittent duty, permitting the unit to be plugged into any standard lighting circuit without danger of overloading or burning out fuses.

Overhead Lights Easy to Keep Clean

PENDANT and ceiling-mounted electric-light fixtures that can be maintained without the use of ladders would seem to have much to recommend them, for they will probably be cleaned oftener than they would be under ordinary circumstances, judging by what happens in the average office and plant. It is a fact that a film of dirt may dim a lamp from 20 to 60 per cent, and yet they are generally allowed to burn at such reduced efficiency simply because it is too much trouble to get at them.

Arguing that an overhead light that can be reached conveniently will receive more attention, the Benjamin Electric Manufacturing Company has produced a so-called floor-service Turnlox fixture together with a reflector changer consisting of a light-weight shaft carrying an engaging mechanism. By means of this device a person standing on the floor can with a quick 90° turn remove and again put back in the socket a lamp as high up as 18 feet. The globe, reflector, and bulb constitute a unit, and the electrical and mechanical connections with the socket are made through a substantial 3-point, self-centering bayonet lock that is provided with automatic polarizing contacts.

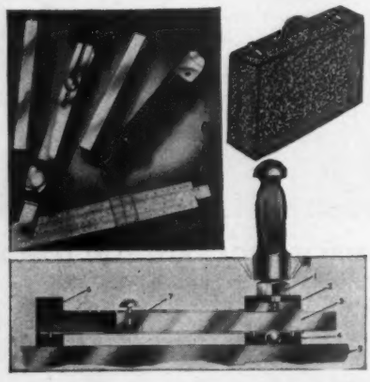
Portable Brinell Instrument for General Service

A LIGHT-WEIGHT Brinell instrument that can be carried easily to the job is simplifying the work of making hardness tests in the field and around industrial plants remote from laboratory facilities. It is known as the Telebrineller, and was developed by one of the oldest and largest railroad-rail-maintenance organizations in the United States for the purpose of checking and controlling the rebuilding (welding) and heat-treating of rail ends on the right of way.

The outfit is made up of the Telebrineller or instrument proper, of a microscope with a scale etched in its focal plane, and of a slide rule, all packed in a case with test bars and impression balls. The instrument, itself, consists of an anvil *1* in a soft rubber head *2* resting on a test bar *3* of known hardness, of an impression ball *4* which comes in direct contact with the metal to be tested *5*, of a rubber spacing block *6*, and of a spacing bar *7* operated by a spring catch and button.

To make a test, the instrument is held against the specimen and the anvil is struck a sharp blow with a 3- to 5-pound hammer, the impact being transmitted equally through the bar and ball to the surface of the metal undergoing test. The force of the blow is not a factor, and the diameter of the resulting impressions in the bar and specimen are relative to their individual Brinell hardness numbers (BHN). The diameters are then measured in 1/10 millimeters by placing the microscope over each in turn. After that it is a simple matter to arrive at the BHN by means of either an arithmetical formula or a slide rule. One test bar, if all its four faces are exposed throughout their full length to the impact of the hammer, is good for 80 impressions.

According to the manufacturer, the instrument is built to withstand hard use and can be applied without previous training or experience. It is not affected by hot or cold weather, and is suitable for work in close quarters and in connection with parts and equipment which, because of their size, have heretofore made testing difficult, expensive, and sometimes well-nigh impossible. Complete with case, the Telebrineller weighs only 6½ pounds.



New Safety Fuse

THE Ensign-Bickford Company has announced a new detonating fuse for blasting service that acts in the same manner as Cordeau-Bickford but is a decided improvement upon it. The new fuse, which is called Primacord-Bickford, differs from Cordeau in two ways: Its explosive core consists of pentaerythritetetranitrate (PETN), not of trinitrotoluene (TNT); and it is inclosed in a waterproofed textile covering instead of a lead tube.

Primacord cannot be set off by friction, fire, or any ordinary shock, but must be detonated by a blasting cap attached to it. No blasting caps are required at the explosive itself, as the Primacord acts as the detonating agent for each cartridge. Accordingly, no caps are present during the loading of holes, and much of the danger attending the preparation of blasts is therefore eliminated. The fuse itself is of such a harmless nature that it is accepted for shipment by transportation companies with no restrictions other than that it must not be packed with blasting caps or high explosives.

The action of Primacord is almost instantaneous, as its explosive wave travels 20,350 feet per second, or 20 per cent faster than that of Cordeau. Even so, in firing, there is claimed to be a sufficient delay between adjacent holes or adjacent rows of holes to allow for relief of burden, thereby promoting effective blasting with a minimum amount of explosive.

Primacord weighs approximately 15 pounds per 1,000 feet, or about one-fifth as much as Cordeau, and is wound on wooden spools containing 500 or 1,000 feet. It is suitable for use for all kinds of blasting work, including the submarine field.

Industrial Notes

According to the American Petroleum institute, gasoline taxes for 1937 will total approximately $1,000,000,000, or about 7 per cent of the nation's industrial payroll.

Aluminum-coated steel that can be rolled and drawn into different shapes and dyed a variety of colors is available under the trade name of Alplate.

Another fireproofing material has reached the market. It is a colorless, odorless liquid called Pyron that can be applied directly to fabrics or mixed with paint thinners or paint to protect flammable structures or articles.

According to information from Japan, an ingenious pneumatic machine has been invented there for imprinting designs in five colors on glasses, bottles, rubber balls, tin containers, and a variety of other articles presenting convex surfaces. The press has a rated capacity of one 5-color print every six seconds, or 600 an hour.

A magnetic separator for use in connection with fluids has been announced by Stearns Magnetic Manufacturing Company. It is in the form of a filter, and is designed to remove tiny bits of iron and kindred foreign matter from fluid materials used in the manufacture of porcelain, glass, refractories, and the like.

With the approach of winter, the motorist may be interested in a new type of skid chain that is guaranteed not to arouse his ire during application. The manufacturer claims that it can be put on a wheel without moving it or reaching behind it. EasyOn is the trade name. The chains may be purchased for from $4.10 to $9 a pair.

The American Institute of Mining and Metallurgical Engineers has just released a 960-page volume entitled *Industrial Minerals and Rocks*. This comprehensive treatise fills a long-felt want for accurate and up-to-date information on industrial minerals of all kinds. Each of its 48 chapters covers a specific subject, and was written especially for this work by a recognized authority in that field.

Prefabricated timbers, ready for assembly, are being turned out by a company organized by a group of Oregon and Washington lumber manufacturers. The output is marketed through the medium of authorized retail lumber dealers, and consists of such standard units as roof trusses, oil derricks, walking beams, pipe racks, bridges, etc. The company is prepared, however, to design and to erect special structures. It is known as the Western Timber Structures, Inc., and is located in San Francisco, Calif.

Under the name of Flintcrust, the Flexrock Company is offering a compound that is said to harden concrete floors and to prevent them from giving off dust. It is dissolved in water and flushed over the surfaces, three applications, one after another, being required.

The familiar rubber sponge has a rival, according to a recent announcement by E. I. du Pont Nemours & Company. The new artificial sponge is the product of that company's rayon department, and is made of pure cotton and cellulose. It has high absorptive properties, taking up more than twenty times its weight in water; when squeezed dry can be used in place of chamois; and can be cleaned and sterilized.

Bendalloy, a Cerro de Pasco Copper Corporation metal that is widely used in bending thin-walled tubing, has been given the new name of Cerrobend. The material melts at 160°F., and was recently applied with success in the case of open, thin-walled molding. In addition to filling its internal spaces, the molding was embedded in the alloy, which was removed after the bending operation by steam heat or a bath in boiling water.

Shellac in needle form is being produced by a special spinning process in Belgium. The advantage claimed for it is that it contains not more than 2 per cent of moisture, as compared with approximately 5 per cent for powder or leaf shellac and about 25 per cent for button shellac. The material dissolves easier because of the low moisture content, which also imparts to it other desirable properties.

The work of salvaging the vessels of the German fleet sunk in Scapa Flow during the World War continues. Recently the 25,000-ton battleship *Friedrich der Grosse* was raised from a depth of 23 fathoms with the aid of ten air locks. After the superstructure had been blasted away, the hull was towed to the yard of Metal Industries, Ltd., at Rosyth, Scotland, where it will be broken up. It is estimated that it will yield some $75,000 worth of scrap metal.

Red and purple marking fluids that can be applied to metal surfaces with rubber stamps or the use of stencils have been produced by Dykem Company. In the case of the former, the impressions are said to be legible even when the lettering is very small. The resultant coating dries in ten seconds and resists moisture, cold, oil, and frequent handling. The fluids will penetrate a thin film of oil and do not chemically affect the surface of the metal. The company is prepared to provide samples upon request.

Recent reports from abroad reveal that sewage gas is being used in Germany as a motor fuel. Many trucks and other heavy automotive vehicles have been equipped to run on this former waste product, which is dispensed at service stations especially designed for the purpose. There the gas is compressed and stored in metal flasks having a capacity of approximately 500 cubic feet. It is said that one such container will serve to drive a 5-ton truck 75 miles, which means an average consumption of 6⅔ cubic feet of gas per mile. The trucks are arranged to carry several of these flasks.

Sealed against dust, moisture, and vapor, the Millite Luminaire, a new Westinghouse Electric & Manufacturing Company lighting fixture for industrial use, will give a maximum of illumination with a minimum of maintenance. Ordinarily, lighting fixtures require frequent cleaning if they are to give efficient service, and it is no uncommon thing for a 500-watt bulb exposed to dust and fumes to give the equivalent of only 100 watts of light shortly after washing. The new unit is entirely encased in steel and glass, the joint between the two being made tight with a ring and gasket. Radiation takes care of the heat generated. Another feature of the lamp is its lens—a flat, clear disk of glass highly resistant to heat and changes in temperature and hard to break except under the impact of a sharp blow. When it is shattered it breaks into small blunt pieces. An aluminum reflector and a socket for a 750- or 1,000-watt incandescent bulb completes the fixture.

Pennsylvania State College has recently increased from five to eight the members of its research staff engaged in the study of the secondary recovery of petroleum by water-flooding. The process was developed in Pennsylvania, but is now being used in other oil fields both here and abroad. By means of it, water under pressure is admitted through predetermined wells into an oil-bearing formation and serves to force the oil out through other nearby wells. The work, however, has more or less been done by the rule-of-thumb method. Recognizing the need of standardized practices, a group of oil men several years ago formed what is known as the Bradford District Research Group. It is this organization which is sponsoring the water-flooding investigations at State College that have already made it possible to replace speculation with fact and to substitute scientific for hit-and-miss production methods.

Smokeless Chimneys a Possibility

SPOTLESS TOWN, something very desirable but difficult of attainment, may be one step nearer realization as the result of research work being conducted by members of the metallurgical staff of the U. S. Bureau of Mines. That organization, like others, is bent on finding a practical solution of the smoke-pollution problem, and has developed a method that promises to have far-reaching benefits. It was demonstrated some time ago in New York at an Air Polution show sponsored by the Smoke Abatement Association, and proved that it is possible by means of sound waves of extremely high frequency to settle dust, fumes, and smoke.

In 1866, Kundt discovered that sound waves passed through a tube containing a fine powder will cause that powder to concentrate at points free from vibratory motion. It has also been known that high-frequency sound waves affected the diffusion of solid or liquid particles in a gas. With these facts as a foundation to build on, the Bureau of Mines developed its method, initially for the purpose of treating smelter fumes. It consists of simply passing the smoke or fumes through a tube in which standing sound waves are maintained. The tube must be carefully proportioned, however, and must be of such a length that the waves reflected from the upper end are in phase with the original sound waves produced at the lower end. Furthermore, to get the best results, the wave length must be approximately equal to the diameter of the tube. For a tube of practicable diameter, this would call for frequencies ranging from 3,000 to 20,000 cycles per second.

For the demonstrations mentioned, two types of generators were employed to set up sound waves of the proper frequency: a magnetostrictive generator and a Hartmann acoustic air-jet generator. The former depends for its effectiveness upon the change in length of a magnetic material in a magnetic field, and the latter is nothing more than a shrill whistle of special design. As explained in *Combustion*: The sound waves produced by one or the other are reflected at the top of a closed glass tube so as to be in phase with the original wave, setting up standing waves separated by planes of no motion, called nodes, spaced approximately 1½ inches or half a wave length apart. In its complicated movement between nodes, the suspended matter collides and thus coagulates, the heavier flocculated masses finally collecting at the points of no motion.

The Bureau of Mines is now engaged in developing practical apparatus which, in addition to treating smelter fumes, will also serve generally for smoke and dust abatement. It is worth noting that it is the purpose of the bureau to patent the system so that the American public may reap the full benefits therefrom.

Fertilizer

A Mennonite's market stall near the home of Lebanon Steels.

. . . and the flowers you admire

WHEREVER SEEN, at the market stall, in the garden, on the table, flowers are unlikely to suggest the glowing, molten metal of the steel foundry.

Yet there's a link between Lebanon Stainless Steels and the flowers you admire. The link is the fertilizer that feeds roots in the garden. The engineer of any plant in the chemical process industries could tell you of the vital role played by stainless steels in the handling of phosphates, nitrates and other fertilizer bases.

The processing of these chemicals exposes equipment to the severest corrosion. For fertilizer men, the advent of Lebanon "Circle L" Stainless Steels was a blessing—without disguise. The remarkable corrosion resistance of these alloys was recognized as the answer to many problems of long standing. Today, they fight in the cause of lower costs under the banners of many of America's greatest industries.

HIDDEN PROFITS? In your own plant, profits may lie hidden beneath corrosion's ugly face. Equipment damage and replacements which you have accepted as inevitable may vanish with the introduction of "Circle L" Alloys. Know! Arrange an appointment between your plant engineer and a Lebanon specialist—others have found it paid.

LEBANON STEEL FOUNDRY

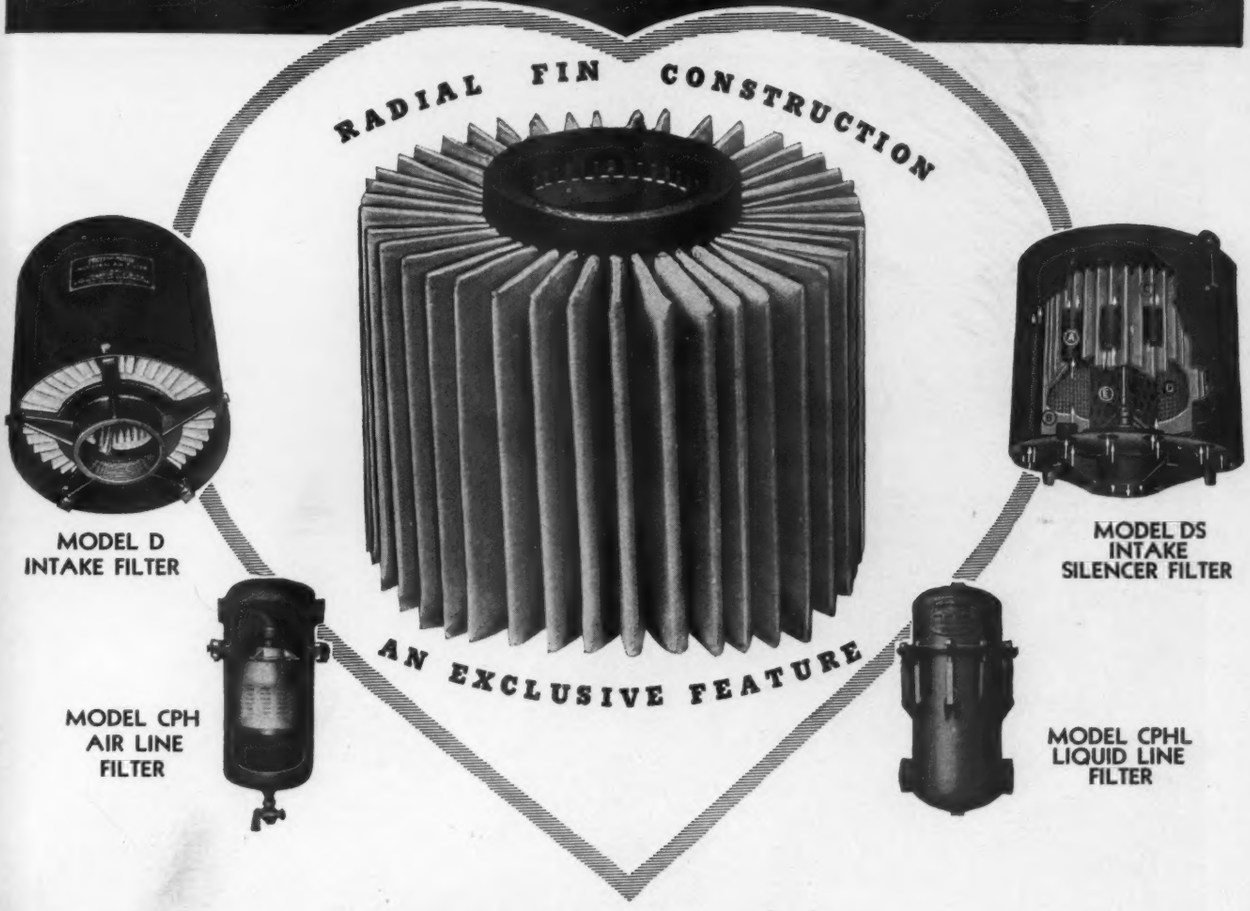
EXCLUSIVE AMERICAN LICENSEE FOR GEORGE FISCHER METHOD SCHAFFHAUSEN, SWITZERLAND

CIRCLE L

LEBANON, PENNA.

Stainless and Special Alloy Steel Castings

THE HEART OF EVERY PROTECTOMOTOR

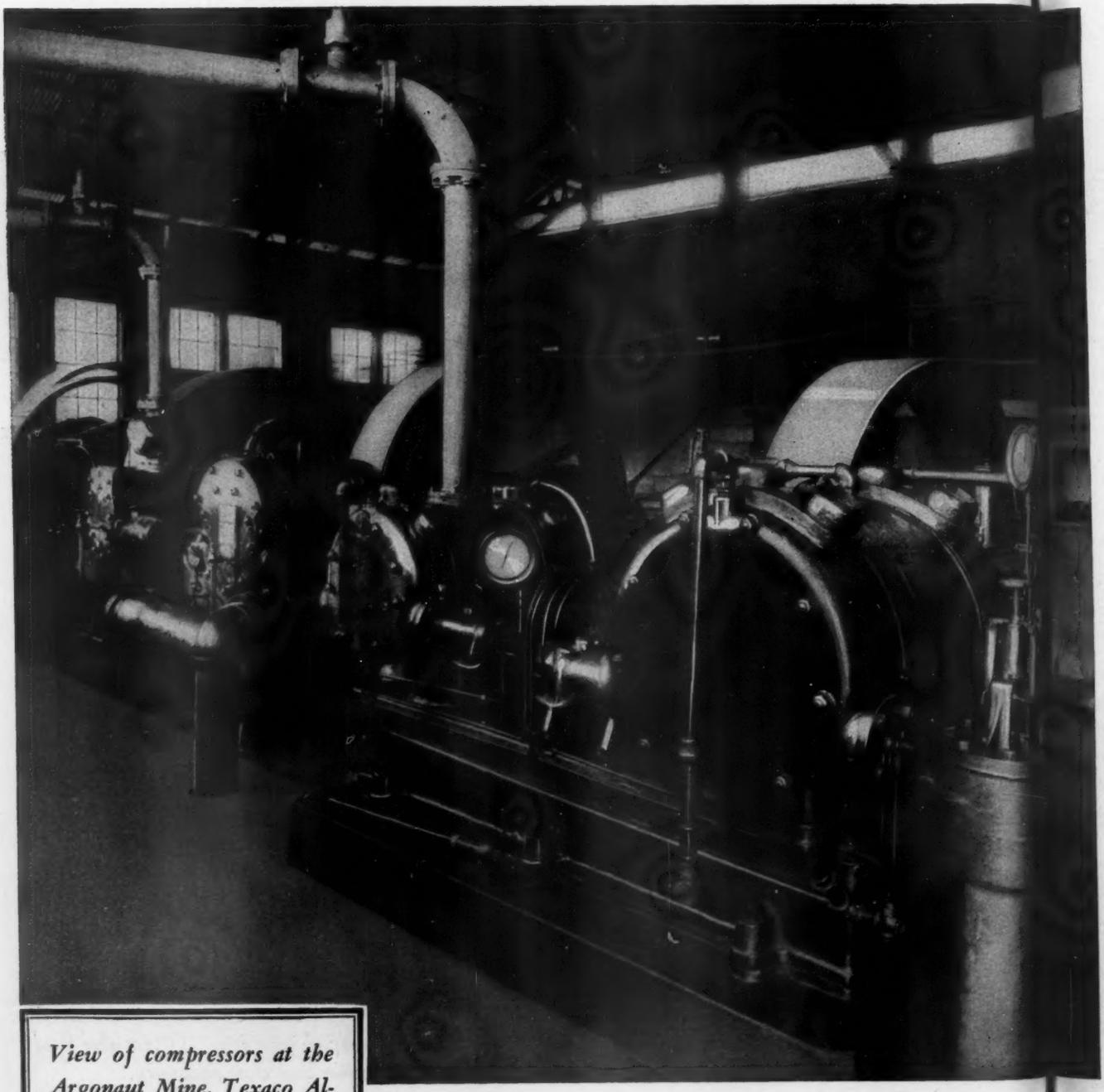

RADIAL FIN CONSTRUCTION
AN EXCLUSIVE FEATURE
MODEL D INTAKE FILTER
MODEL DS INTAKE SILENCER FILTER
MODEL CPH AIR LINE FILTER
MODEL CPHL LIQUID LINE FILTER

RADIAL FIN CONSTRUCTION—an exclusive, patented feature found *only in Protectomotor* Air Filters for intake on engines and compressors and for pipe line filtration—has two major advantages: FIRST, it possesses a large area of filtering surface in relation to the overall size of the insert. An insert in the Radial Fin Construction only 11" high x 8¼" in diameter has an active filtering surface area of 1325 sq. inches! This means low resistance to air flow, high efficiency and long, maintenance-free life. SECOND, the Radial Fin Construction is the best form ever devised to resist pulsating intake. It has no broad, flat surfaces to break down under the destructive pulsation of a hard-driven internal combustion engine or compressor. Each rigid, wire mesh framed fin opposes an *arch* to the force of inrushing air. Write today for the latest catalog describing Protectomotors in detail. Mention special interests. *Filters also made for ventilation and dust recovery.*

STAYNEW FILTER CORP. "Air Filter Headquarters"

7 Leighton Ave. PROTECTOMOTOR AIR FILTERS Rochester, N. Y.

In the famous



View of compressors at the Argonaut Mine. Texaco Alcaid keeps rings free, valves properly seating, the whole compressor clean.

TEXACO

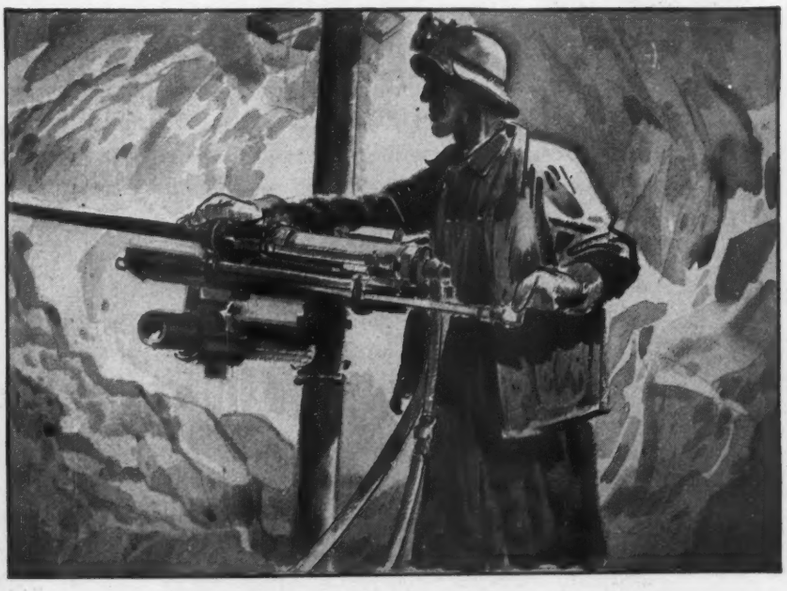
MOTHER LODE...

"THE ARGONAUT MINE at Jackson, Amador County, is situated in the heart of the famous Mother Lode of California. This gold mine is mining ore from the 6,000 foot level where some of the working faces are approximately 1½ miles from the compressors. The compressors supplying the compressed air are lubricated with Texaco Alcaid Compressor Oil." The above is from a letter written by Alex F. Ross, Superintendent.

From experience, Mr. Ross knows that Texaco Compressor Oils can be counted upon to give him long, continuous service. He knows that they keep his compressors *clean,* free from gumming and consequent ring sticking with which he formerly was faced.

Trained lubrication engineers are available for consultation on the selection and application of Texaco Compressor and Air Tool Lubricants. Prompt deliveries assured through 2070 warehouse plants throughout the United States.

The Texas Company, 135 East 42nd Street, New York City.



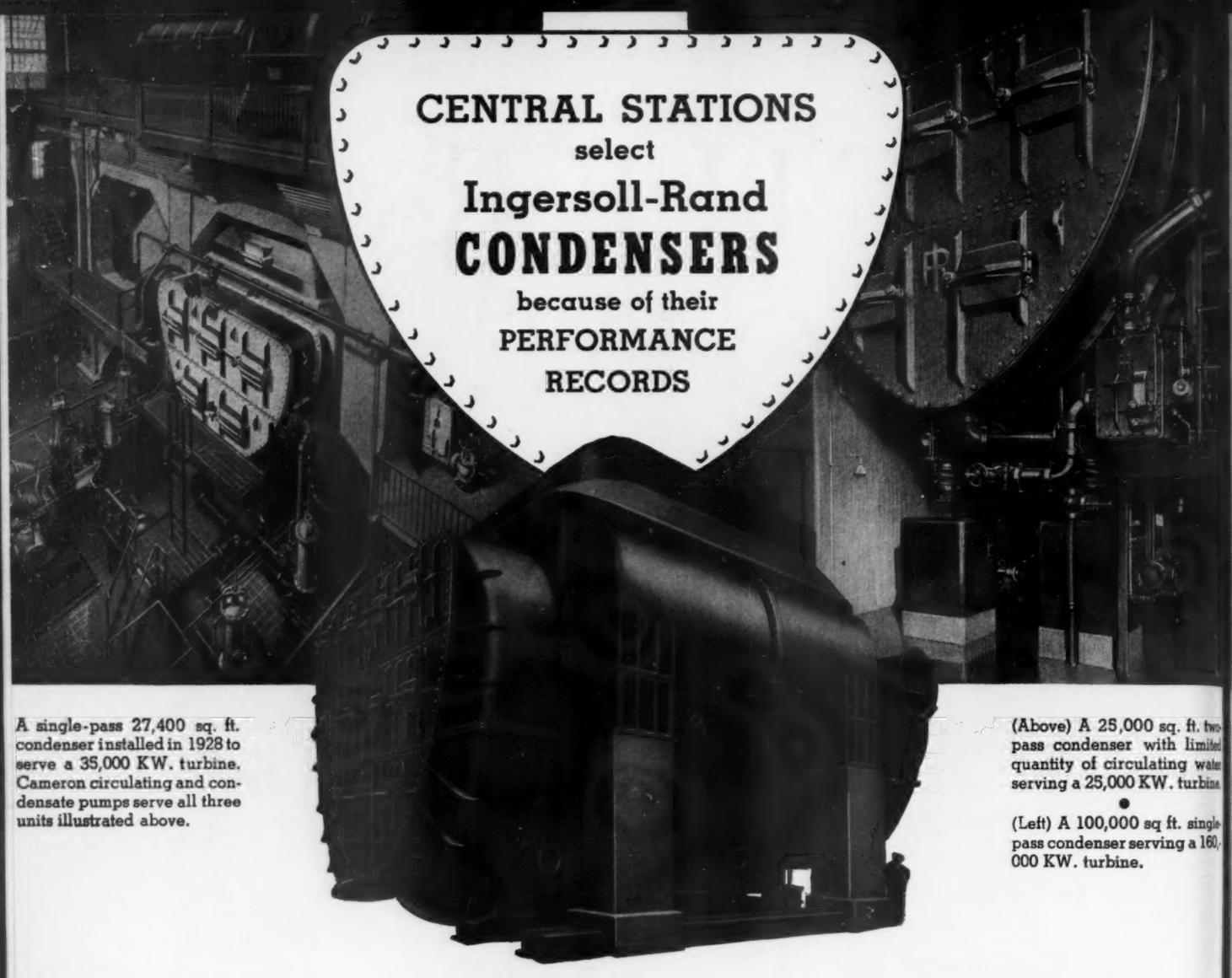
AIR TOOLS—You can be sure of a big day's work . . . every day . . . for each drill, when it's on Texaco. And this is all anyone can expect of his drills. Above all, don't attempt to save money on air tool lubricants . . . you'll end by having to spend several times more on repairs than your "savings."

TEXACO

REG. T. M.

COMPRESSOR AND AIR TOOL *LUBRICANTS*

CENTRAL STATIONS
select
Ingersoll-Rand
CONDENSERS
because of their
PERFORMANCE
RECORDS



A single-pass 27,400 sq. ft. condenser installed in 1928 to serve a 35,000 KW. turbine. Cameron circulating and condensate pumps serve all three units illustrated above.

(Above) A 25,000 sq. ft. two-pass condenser with limited quantity of circulating water serving a 25,000 KW. turbine.

●

(Left) A 100,000 sq ft. single-pass condenser serving a 160,000 KW. turbine.

Features —

All of the I-R installations referred to here are operating with a uniformly high surface efficiency rendered possible by the following features of design:

- ***Heart Shaped Shell***
- ***Differential Tube Spacing***
- ***External Coolers***
- ***Positively Controlled Steam Distribution***

Cameron Pumps

The complete line of Cameron pumps includes circulating, condensate and hot-well pumps, and boiler-feeders for discharge pressures up to 2800 lbs. per sq. in. Other I-R power house equipment includes air ejectors, vacuum pumps, compressors, and pneumatic tools.

OVER a million kilowatts of large Ingersoll-Rand single-pass Condensers (30,000 KW. and larger) installed during the past 15 years, represent an average of 0.7 sq. ft. of condensing surface per kilowatt. Hundreds of I-R multi-pass condensers average less than 1.0 sq. ft. per kilowatt. The generally accepted standard of condensing surface per KW. during this period was about twice these figures.

The Ingersoll-Rand standard for those 15 years has now become the performance standard demanded by modern power plants. Before purchasing condensers rated on this new standard, it will pay you to consider the performance record of past installations, and to investigate the design pioneered and perfected by Ingersoll-Rand. The ability of the I-R Condenser to maintain this more efficient performance over extended periods, and under a wide range of operating conditions has been conclusively demonstrated in a great many Central Stations throughout the country.

5664

Atlanta
Birmingham
Boston
Buffalo
Butte
Chicago
Cleveland
Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Kansas City

Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

Branches and agencies throughout the World

Knoxville
Los Angeles
Newark
New York
Philadelphia
Picher
Pittsburgh
Pottsville
Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
Tulsa
Washington

Tunneling is a Hercules Job

The opening of the Broadway Tunnel connecting Oakland (Alameda County) with Contra Costa County marks another big construction job made possible by Hercules explosives and Hercules service.

Contractor R. G. Clifford, of San Francisco, used Hercules explosives exclusively in completing the work on the 2,900-ft. twin bore that is winning acclaim on the West Coast.

For tunneling and all rock-moving work, get the economy and performance of Hercules explosives and make use of Hercules technical service.

HERCULES POWDER COMPANY
Incorporated
932 KING STREET
WILMINGTON, DELAWARE

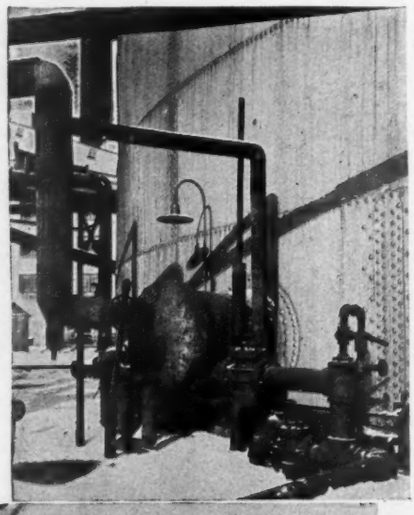
Z-12

Vogt

HEAT TRANSFER EQUIPMENT

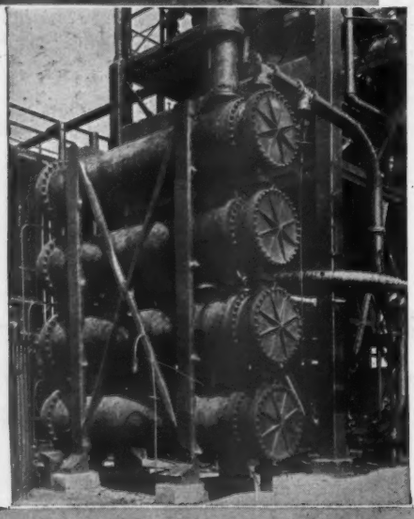
for

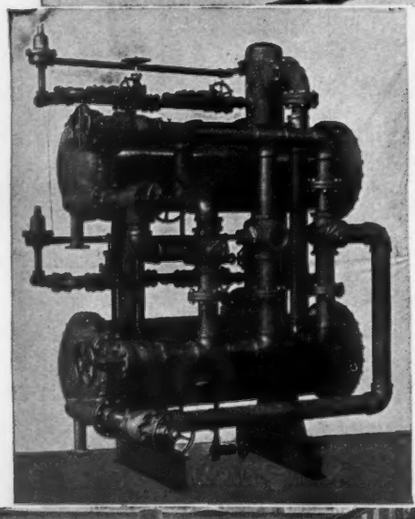
HEATING, COOLING AND CONDENSING LIQUIDS, VAPORS AND GASES

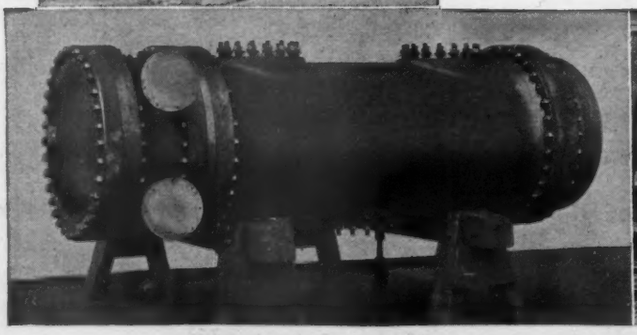


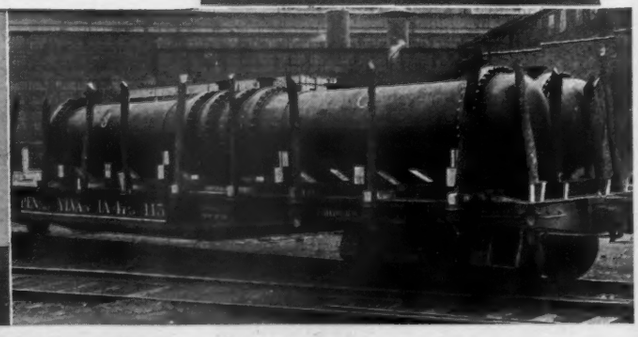
Oil refineries, chemical plants, power plants and related industries are operating Vogt heat transfer equipment with entire satisfaction.

Let our engineers study your problem and recommend types that will exactly meet your requirements.



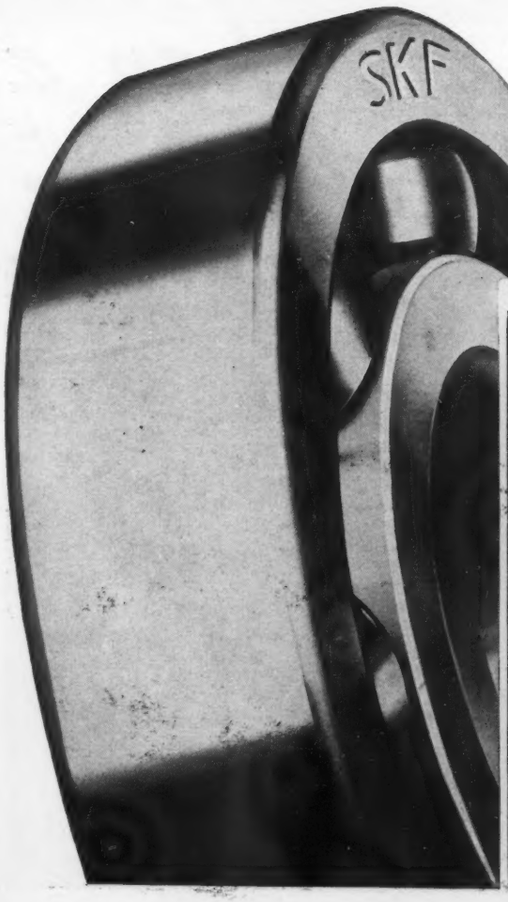






HENRY VOGT MACHINE CO., *Inc.* LOUISVILLE, KY.

NEW YORK CHICAGO CLEVELAND PHILADELPHIA CINCINNATI KANSAS CITY DALLAS



SKF-EQUIPPED BUILT BY INGERSOLL-RAND CO.

ONE MAN DRILLS

are free from bearing trouble if they're SKF*-equipped*

● One man has absolute control over both the drilling speed and bit pressure with this light Explorer Diamond Drill. And contributing in a big way to the dependability and compactness of this machine are SKF Ball Bearings on back and motor shafts . . . journal and feed nut assemblies.

High in capacity, smooth, efficient, SKF Bearings never require adjustments, need only occasional lubrication, and maintain their close tolerances year in and year out. They measure up to the most exacting demands made upon them. Follow the leaders to SKF Bearings.

MORE THAN
1200
TYPES AND SIZES
Industry comes to SKF for unbiased bearing counsel because SKF makes practically all types of anti-friction bearings.

3997

SKF INDUSTRIES, INC., FRONT ST. & ERIE AVE., PHILA., PA.

SKF

BALL AND ROLLER BEARINGS

Needs no more air than a "Jackhamer"

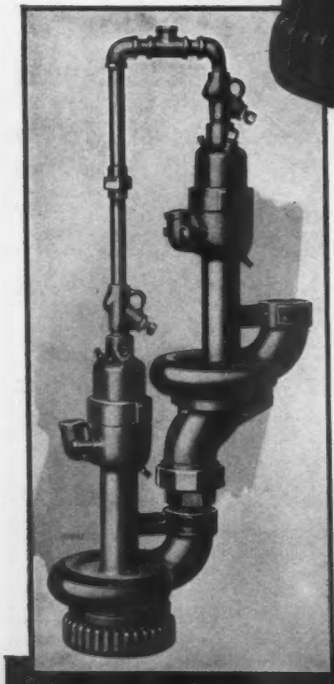
THE SIZE 25 SUMPUMP

(AIR-OPERATED)

If you want your smaller pumping jobs handled quickly and inexpensively, use a Sumpump. It uses no more air than an ordinary "Jackhamer" and will handle 200 gpm against a 25 ft. head. It is compact—one man can carry it anywhere.

It will pump clear or dirty water, oil, sewage or moderately heavy sludge. The unit can be depended upon for reliable service no matter how severe the working condition.

We believe that one or more of these pumps will prove to be a profitable investment. Phone, wire or write to the nearest I-R office and ask to see a Sumpump in action.



SIZE 25-T TANDEM SUMPUMP

Two Sumpumps can be furnished coupled together as shown, to act as a two-stage pump for higher heads than the standard pump will handle. This two-stage pump, known as the 25-T Tandem Sumpump, is good for heads up to 240 feet with 100 lbs. air pressure or 160 feet at 80 lbs. air pressure and is very useful for dewatering shafts, etc.

The I-R line includes 1000 sizes and types of air compressors, 500 rock drills, paving breakers, clay diggers, hoists, pneumatic tools of all kinds, pumps, diesel engines and much accessory equipment.

Atlanta
Birmingham
Boston
Buffalo
Butte
Chicago
Cleveland
Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Knoxville

Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

434-B

Los Angeles
Newark
New York
Philadelphia
Pittsburgh
Pottsville
Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
Tulsa
Washington

"SINCE MY LAST CALL ON THE ABOVE PLANT I FIND"

—*A Typical Beginning* of some 25,000 impartial reports by Socony-Vacuum Field Engineers...to guide us in refining oils suited to actual Plant conditions

How Socony-Vacuum Engineering Service can save money in your plant:

1. Curb losses that boost power consumption and costs.
2. Decrease maintenance.
3. Improve production results by greater machine efficiency.
4. Lower lubrication costs.
5. Help your men find ways to devise important economies.

TONIGHT—in hotels across the country—Socony-Vacuum Field Engineers are writing their reports!

News of what Gargoyle Lubricants did today *in service*.

News of new methods...problems.

These hard-boiled facts leave no loopholes. Gargoyle Lubricants must meet operating conditions!

Because they do—Socony-Vacuum "Correct Lubrication" has saved millions in 110 different industries. Improved production. Lowered power, maintenance and oil costs.

The advice of a Socony-Vacuum Engineer may result in surprising economies in your own plant. A word from you will bring him there.

SOCONY-VACUUM

CORRECT LUBRICATION

GARGOYLE Lubricants

SAVES MONEY FOR INDUSTRY

Read what 71 Years' Lubricating Experience...the Greatest in the Oil Business...can do for You. See Next Page.

THIS MARKETING POLICY MEANS "CORRECT LUBRICATION" FOR EVERY TYPE OF PLANT

INDUSTRY ALMOST ALWAYS FINDS that the controlled use of high-grade Gargoyle Lubricants pays for itself many times over and that they actually cost less to use than ordinary lubricants.

But, for such equipment as does not justify the highest-grade lubricants, Socony-Vacuum Engineers will always recommend a lower-priced lubricant when consistent with true economy.

Socony-Vacuum, with a complete line of products, can supply the lubricants best fitted for the requirements of the individual lubricating job as determined by specific operating conditions.

Socony-Vacuum Engineers bring you years of world-wide experience and direct cooperation with manufacturers of equipment. Lubrication Profit is the inevitable result.

SEND FOR THE SOCONY-VACUUM REPRESENTATIVE: *The services of a trained Socony-Vacuum Engineer are available at all times in helping your men to solve lubrication problems.*

SOCONY-VACUUM OIL CO.
INCORPORATED

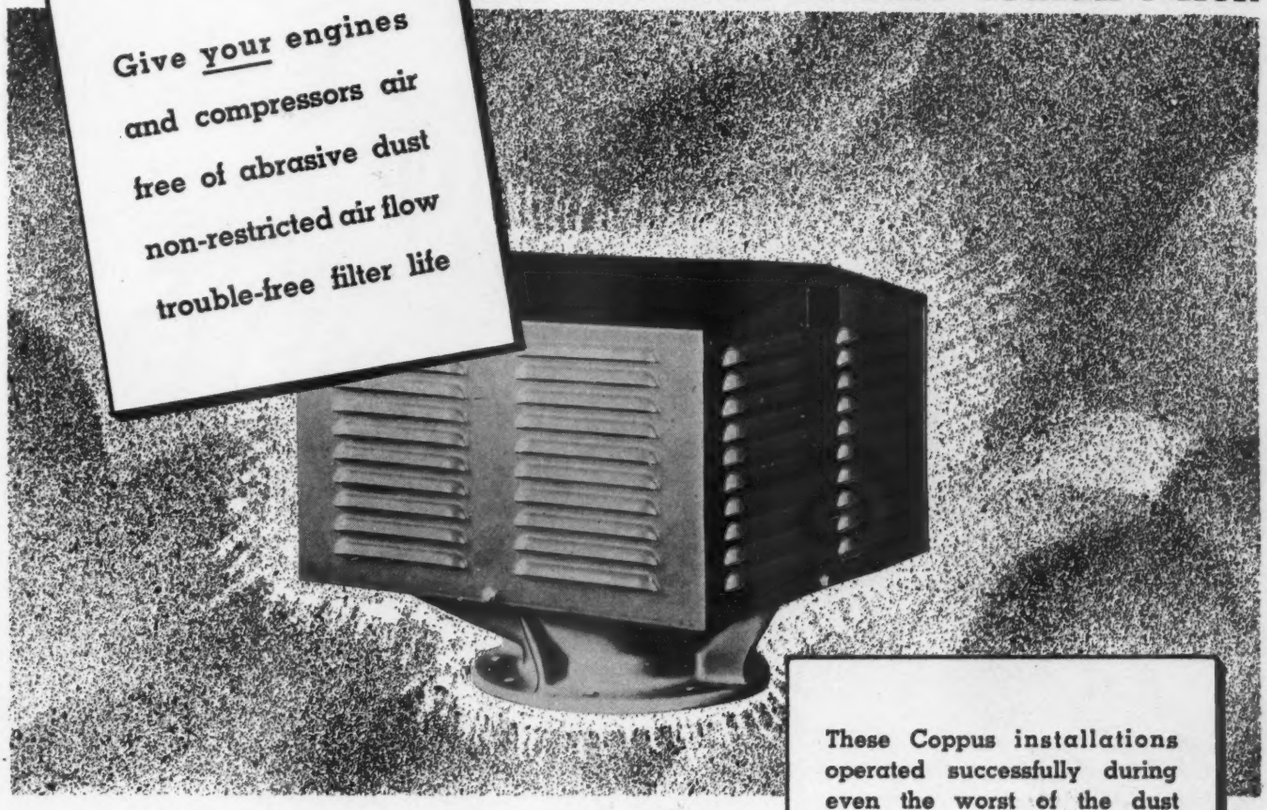
STANDARD OIL OF NEW YORK DIVISION · WHITE STAR DIVISION · LUBRITE DIVISION · WHITE EAGLE DIVISION
WADHAMS OIL COMPANY · MAGNOLIA PETROLEUM COMPANY · GENERAL PETROLEUM CORPORATION OF CALIFORNIA

GARGOYLE Lubricants

This is the Filter

that the Dust Storms couldn't lick

Give your engines
and compressors air
free of abrasive dust
non-restricted air flow
trouble-free filter life



Coppus Air Filters are accepted and listed by manufacturers controlling the sale of 96% of the country's air compressors and stationary engines.

Here's complete protection — no matter how bad conditions get. 95.6% efficiency against even 2 micron size dust (99.9% against 10 microns).

Modern steel framework — no wires, few welds, vibration-proof. Non-clogging — no narrow openings, no oil. Self-cleaning under most conditions.

Write for Bulletin F-310-3 to Coppus Engineering Corp., 370 Park Ave., Worcester, Mass. Sales offices listed in THOMAS' REGISTER.

These Coppus installations operated successfully during even the worst of the dust storms:

U. S. Gypsum Co., Kansas City, Mo.
J. E. Crosbie, Inc., Tulsa, Okla.
Southern Rock Asphalt Co., Dougherty, Okla.
Greenfield Gin Co., Greenfield, New Mexico.
City of Stockton, Stockton, Kansas.
Village of Sutherland, Sutherland, Neb.
City of Curtis, Curtis, Neb.
Panhandle Eastern Pipe Line, Kansas.
Atchison Topeka, Santa Fe Rlwy. Co., La Junta, Colo.
The Inland Utilities, Scott City, Kansas.
Tulsa Ice Co., Tulsa, Okla.
Phillips Petroleum Co., Borger, Texas.

CLEAN AIR FOR MEN AND MACHINES COPPUS

Other Coppus Products: filters for industrial and general ventilation: Heat Killer; ventilators and blowers of many types; steam turbines; forced draft blowers.

COPPUS AIR FILTERS PASS CLEAN AIR

7543

NORTON ABRASIVES
NORTON CUT-OFF WHEELS
Variety — in abrasives and bonds —that's one reason for Norton success in every cut-off operation.
Expert Service is another reason—experts who can help you adapt these wheels to your job.
Abrasive wheels are now recognized production tools for cutting-off and slotting operations—are doing the job more economically than other methods and leaving a finish that in many cases eliminates subsequent operations. Let Norton show what they can do for you.
NORTON COMPANY
Worcester, Mass.
W-622
ALUNDUM AND CRYSTOLON ABRASIVES
RESINOID, RUBBER AND SHELLAC BONDS

"Over the Top" 5 times faster with GOODRICH RUBBER

Another typical example of Goodrich development in rubber

ARMIES—like manufacturers—demand improvement.

Tanks have always been limited in speed, range, maneuverability, life, by the heavy steel tracks on which they traveled. Also, noise of this clanking steel disclosed tanks to the enemy, and was so nerve-wracking to crews that they could neither travel far nor fast.

An inventor conceived a track of rubber in which wire cables would be imbedded. Here was an idea, but it existed only on paper—its usefulness depended on the solution of many construction problems.

The inventor came to Goodrich, who developed the correct rubber compound, re-designed the track with smaller cables, perfected the adhesion of rubber to cable, engineered the entire device to make it practical. That is the track of today—producing a tank with far longer range than the same tank with steel track, more maneuverable, and so quiet and free from vibration that crews can stand speeds five times as great as in the old tank. And the rubber track lasts 5 times as long as the former track of steel.

War tanks may be a far cry from your product *but rubber is not.* All the skill in compounding, the experience in rubber making which Goodrich has gained in these thousands of special applications, is available *and used* in making every Goodrich product—belting, hose, packing and hundreds more—longer lived, better fitted to its task, a better value for the user. The B. F. Goodrich Company, Mechanical Rubber Goods Div., Akron, Ohio.

Goodrich

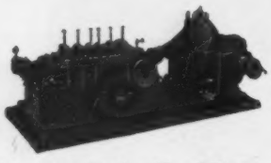
ALL *products problems* IN RUBBER

Ingersoll-Rand Compressors
for Chemical *and* Process *Industries*

OTHER I-R EQUIPMENT FOR THE CHEMICAL AND PROCESS INDUSTRIES

General Service Motorpump

Sizes range from ¼ to 40 hp. with heads to more than 200 ft., capacities from 5 to 1000 gpm. Compact with pump and any type of motor built as one unit on a single shaft. Require no special foundation and will operate in any position. This general service Motorpump will handle a wide variety of liquids used by the chemical and petroleum industries.



Cameron Boiler Feed Pumps

For medium or high-pressure pumping for boiler feed, Cameron Multi-Stage Pumps offer reliable and true economy of power. Capacities range from 20 to 3000 gpm. and for pressures up to and over 1600 lbs. per sq. in. The Cameron line of centrifugal pumps will meet every fluid handling requirement of the chemical industry. Each can be furnished as an all-iron or all-bronze pump.

Air Ejectors

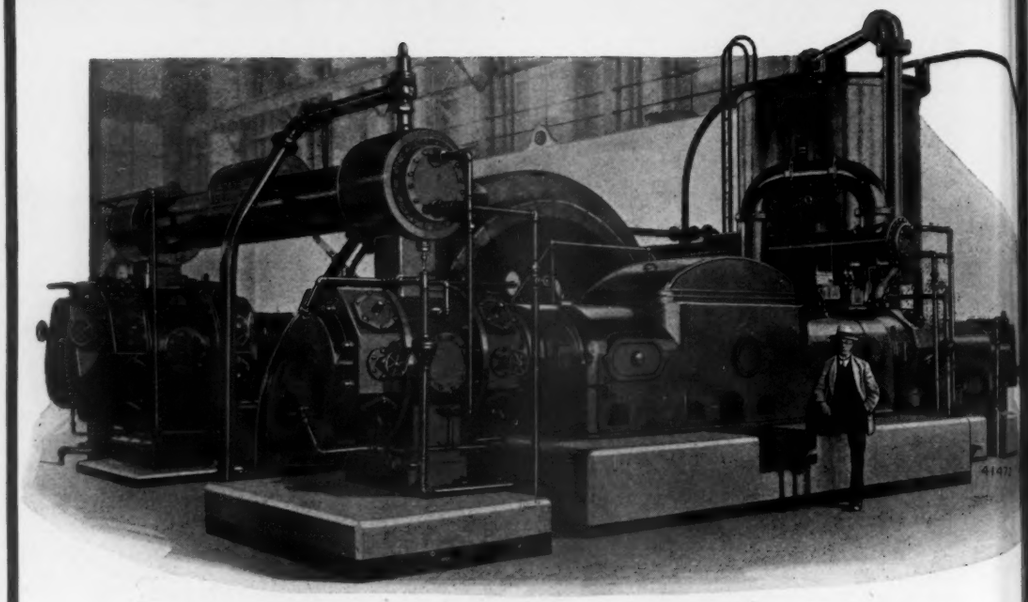
A complete line of high efficiency air ejectors developed for high vacuum beyond the range of ordinary reciprocating vacuum pumps. The type illustrated is a two-stage unit with pre-cooler and surface-type intercooler and after-condenser offered where hot wet gases are to be handled at high vacuums.

Blowers

A complete line of single and multi-stage Motorblowers for furnace, oven, kiln and cupola operation, for lead and copper flotation or any other direct agitation.

Water-Vapor Refrigeration Units

Water is the only refrigerating medium. There is no refrigerant to purchase or replace. They give economical performance at all loads thus assuring low-cost refrigeration. Both steam-jet and motor or turbine-driven centrifugal types are available.



2250 hp. Ingersoll-Rand Six-Stage Direct-Connected Compressor operating at 4500 lbs. pressure. This is one of two machines in this plant compressing a mixture of three parts of hydrogen and one part of nitrogen in the production of synthetic ammonia.

As early as 1896, I-R developed its first high-pressure compressor. Thru these many years we have kept abreast with the great strides of synthetic chemistry and the demands from industry for modern compressors to meet new and widening applications. Today there are thousands of I-R Compressors in use for handling air, gas and ammonia in the manufacture of synthetic ammonia, methanol and petroleum products, including the hydrogenation process, solid CO_2, liquid air, helium and numerous other gases.

There are 1000 sizes and types of I-R Compressors, Vacuum Pumps and Blowers, ranging from ¼ to 12000 hp. No matter how small or how large, each I-R machine has its own special features making it exactly suited for the job for which it is intended.

Consult us regarding any problems you may have in connection with the compression of air and gas or vacuum applications. Our experience is at your disposal.

Further information and literature on any I-R Product will be sent on request.

I-R LITERATURE FOR EXECUTIVES

Send for these Bulletins

Stationary Diesel Engines
Heavy-Duty Single-Stage Compressors
Duplex Two-Stage Compressors
Type XPV Steam-Driven Compressors
Aftercoolers (moisture removers)
Water-Vapor Refrigeration Units
Condensers
General Service Motorpumps
Boiler-Feed Pumps.

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cleveland, Dallas, Denver, Detroit, Duluth, El Paso, Hartford, Houston, Knoxville, Kansas City, Los Angeles, Newark, New York, Philadelphia, Picher, Pittsburgh, Patterson, Salt Lake, San Francisco, Scranton, Seattle, St. Louis, Tulsa, Washington

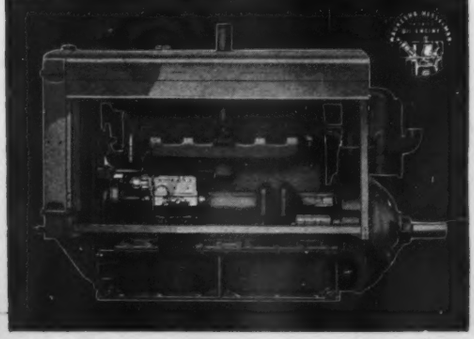
Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y.

540-1

YOU NEED REAL HORSEPOWER

WAUKESHA ENGINES



● The engine that drives gravel plant machinery must have *real* horsepower. The horsepower shown on some performance curve won't turn over a single piece of equipment, if it isn't in the engine.

In the Hartland-Verona Gravel Co. operation at Verona, Wis., the power for driving all equipment is generated in the crushing plant. A 6-cyl., 125-185 hp. EKU Waukesha-Hesselman Oil Engine drives the crushing plant machinery direct, while, at the same time, the washing plant screens and two pit conveyors are driven by motors which receive their current from a 40 kv-a generator, also driven by the engine.

The Hesselman Engine has a sheave for 13 V-belts on its shaft. Nine of them connect to the driving mechanism of the primary crusher, three drive the generator and one the exciter. A system of chains and sprockets from the primary crusher drives the secondary crusher, return bucket, vibrating screen, conveyor over the screen and washing plant conveyor, from its tail pulley. The rest of the mechanical equipment, except the pump, is motor driven.

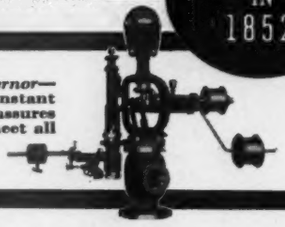
This Waukesha-Hesselman Engine is operating on No. 2 fuel oil, burning an average of 9 gal. per hour. A low compression, solid injection oil engine, with precisely timed electric ignition, the Waukesha-Hesselman Engine burns "modern high speed diesel fuels" with high efficiency; yet weighs no more than, and starts as easily as, a gasoline engine. Real horsepower . . . not paper horsepower. Write for Bulletin No. 1010.

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN

Jarecki
COMPRESSOR EQUIPMENT

★ *Dense, close-grained, cast-iron fittings* — air-furnace malleable fittings—a complete line, accurately threaded and carefully inspected.

ESTABLISHED IN 1852



★ *Erie Compressor Governor*— Maintains slowest constant speed to provide supply; assures constant air pressure to meet all requirements.

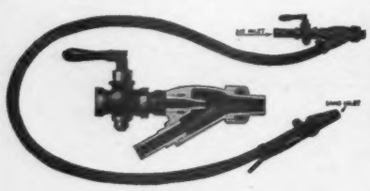
★ *Valves* for every purpose, each with an EXTRA measure of strength. Soundly designed pipe threaders and specialties.

85 YEARS SERVICE TO INDUSTRY

★ *Erie Unloader* — Constant air pressure; completely unloads and loads compressor without shock or strain.

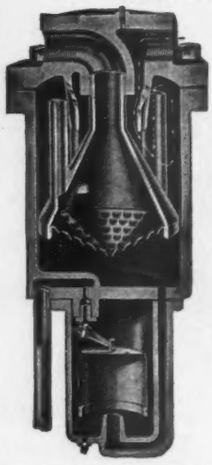
Write for particulars

JARECKI MANUFACTURING COMPANY • ERIE, PA. • U. S. A.



CYCLONE Cleaning BLASTERS for

Cleaning castings and steel (use sand, steel grit or shot). Also used for carving. Simple, inexpensive, economical to operate.



Divide Air Separator and Trap

for removing Oil and Water from Compressed Air. Efficient and dependable.

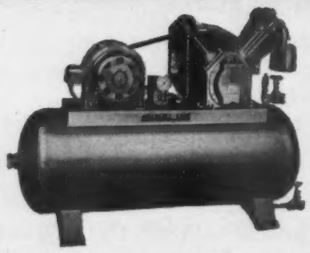
30 years experience designing Separators and Traps.

Send for Catalog

Results Guaranteed

THE DIRECT SEPARATOR CO. Inc.,
SYRACUSE, N. Y.

Do you need a Compressor for:



PAINT SPRAYING
AIR-OPERATED HOISTS
DIESEL STARTING UNITS
PNEUMATIC TOOLS
LIQUID AGITATION
LIQUID TRANSFER
TESTING PURPOSES
CLEANING PURPOSES
AIR-OPERATED CLUTCHES
WHISTLES AND ALARMS
OPERATING PRESSES
AIR LIFT
STONE CUTTING
AERATION
OPERATING CONTROLS
ODD PRESSURES

TYPE 30 units are acknowledged leaders in the small compressor and vacuum pump field. Industrial concerns everywhere are using large numbers of them. They have built into them the same highgrade engineering, manufacturing care and materials as the large 10,000 cu. ft. Ingersoll-Rand machines.

Sizes ¼ to 15 hp. Pressures 5 to 1000 lbs.
Up to 102 cfm Capacity. Ask for Catalog 7502-H

Left—View in a refinery where Type 30's operate control instruments. *Below*—Type 30 used in a department store.

Ingersoll-Rand

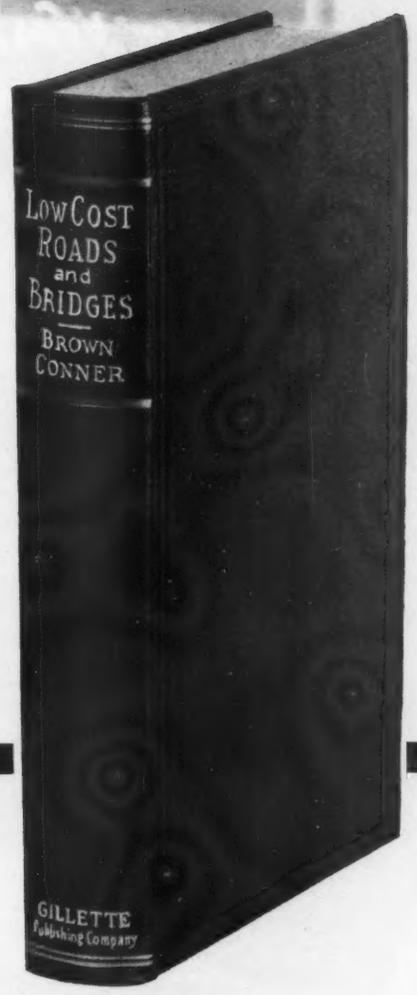
Quantity Deliveries Quickly!

OF **DROP FORGINGS** IN THE MODERN MANNER

Within 300 miles of our plant lies 85% of America's Drop Forging volume. Atlas customers within that area get 24 hour shipping service, plus big tonnage capacity under strict scientific control.

ATLAS DROP FORGE CO. - - LANSING, MICH.

ATLAS DROP FORGINGS
All shapes and sizes to 500 lbs.



LOW COST ROADS *and* BRIDGES

By V. J. Brown, C. E., Publishing Director, Roads and Streets, Assoc. Mem. Am. Soc. C. E., Mem. Western Soc. Eng., Mem. Am. Road Bldrs. Assn.

C. N. Conner, B. S. in C. E., Chairman, Department of Design, Highway Research Board. Formerly Engineering Executive, Am. Road Builders Assoc. Mem. Am. Soc. C. E.

* FREE EXAMINATION OFFER

544 Pages. Illustrated.
$6.00

A treatise on low cost road and bridge design and construction, highly recommended as a criterion of practices and methods.

IN TEN well-arranged chapters the authors have covered the fundamentals of highway design, economics and planning, grading, surface treatment, low cost paving materials and their testing, inspection and maintenance. An additional chapter discusses highway bridges.

The text is so written that it can be used as a field book for actual construction. Step by step processes are described. Of particular value are the discussions on tar and asphalt and the interpretation of tests of these bituminous materials. The manufacture of bitumens for road work is explained. Other useful information is the section which explains what the various trade named and patented product materials are and their distinguishing characteristics.

Engineering of low cost construction and economics of highway types are thoroughly treated. In compiling the text matter Messrs. Brown and Conner state—"The authors' problem was one of selection, correlation and synthesis, rather than research, experiment and analysis."

All the types of low cost surfacing processes are discussed and definite "best practice" methods are explained in detail. When considered in conjunction with the discussions of economics, the text indicates definitely what type of improvement is the most economical for a particular road. In fact, herein lies the greatest value of the book—helping the engineer or executive to decide what type of improvement would be the most economical under particular local conditions.

The authors of this volume were farsighted enough to know that for future construction the economics of highway types would play an increasingly inportant part in improvement programs. They have, therefore, thoroughly discussed this phase of highway planning.

*FREE EXAMINATION OFFER

Gillette Publishing Company.
400 W. Madison St., Chicago, Illinois.

Gentlemen:
Please send me postpaid "Low-Cost Roads and Bridges." In 10 days I agree to return the book or remit $6.00 in full payment for the book.

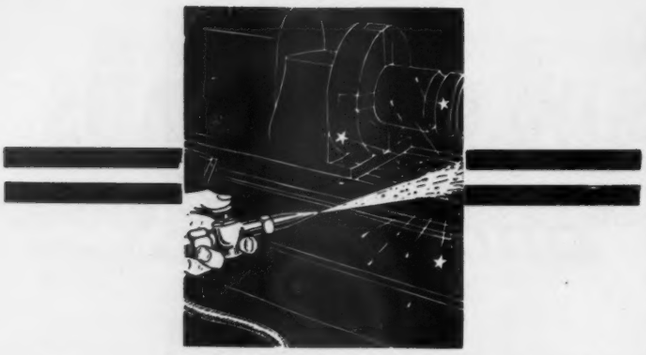
Name .....

Position or Business .....

Address .....

City ..... State .....

C.A.M.—1



None of those shower baths when you use Gast Separators

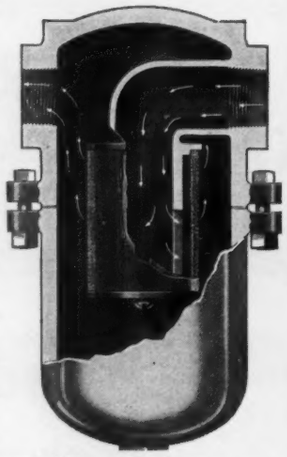
THAT air gun is placed in a man's hands to speed up his work, but if it responds with a shower bath, it's merely a drag on the job—sometimes a source of spoilage.

That is why it pays to use Johnson-Gast Air Separators—the equipment that has proved its ability to keep air lines free from water, dirt or oil in hundreds of plants. A particularly effective operating principle enables the Gast Separator to do a particularly good job of removing water and foreign matter.

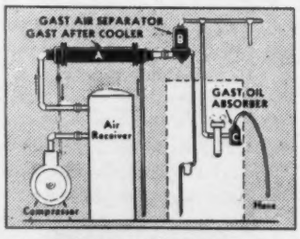
The air, following the course of the arrows as shown in the illustration, expands rapidly as it enters the inner chamber of the separator—an important step in separating entrained water and oil. It then flows through a "thousand baffles" composed of many layers of coarse mesh screen so arranged as to form a tortuous passage that removes 99% (plus) of the suspended water, oil or dirt.

Such separation meets ordinary needs, but if the air has been excessively heated by the compressor, the Gast After-Cooler, illustrated below, is recommended to condense the water or oil vapor so that it can be removed by the separator. In applications such as paint spraying where the slightest trace of oil could cause trouble, a third unit, the Gast Oil Absorber, is installed just ahead of the hose outlet. A typical installation of all three Gast units is diagrammed opposite. Such an installation is the last word in cleaning up compressed air for any use.

The new bulletin contains facts, capacities and installation suggestions. Write.



Note the "thousand baffles" construction. Inlet and outlet are in line so that separator can be dismantled without disturbing pipe connections.



Arrangement of After-Cooler, Separator and Oil Absorber for paint spraying.

The Gast After-Cooler—a remarkably efficient means of condensing water and oil vapor.

THE JOHNSON CORPORATION

830 WOOD STREET — THREE RIVERS, MICH.

GARLOCK 430 CHEVRON for hydraulic service.

GARLOCK 431 CHEVRON for oils at low temperatures.

GARLOCK 530 CHEVRON for steam, air or gas.

GARLOCK 531 CHEVRON for hot oils.

CHEVRON

Reduces Friction to a Minimum!

LIKE the knights of old, GARLOCK Chevron Packing is constantly waging war—*war against wear*—by reducing friction to a minimum. Chevron adjusts itself automatically. The hinge-like shape permits easy expansion and contraction with changing pressures. For rods or plungers operating against steam, air, gas, water, oils and other liquids. Genuine *Chevron* packing is made and sold only by *Garlock*.

THE GARLOCK PACKING CO.
PALMYRA, NEW YORK

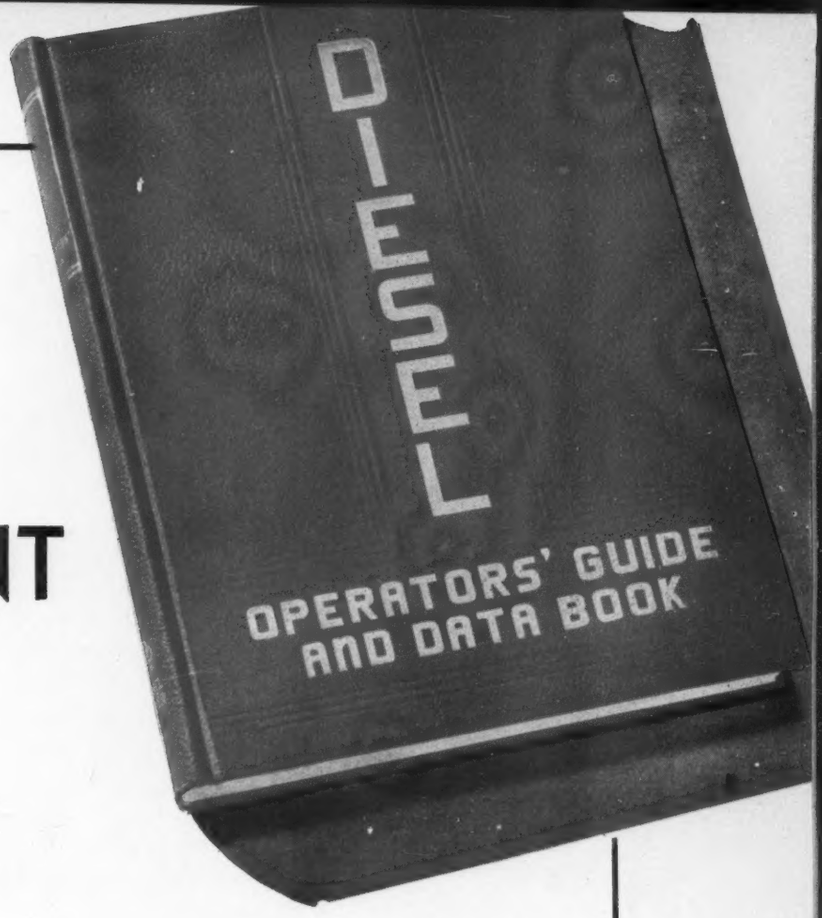
In Canada: The Garlock Packing Company of Canada, Limited, Montreal, Que.

1887-1937 FIFTIETH ANNIVERSARY

GARLOCK

You'll Want This BOOK

IT'S DIFFERENT



Many books have been written about Diesels but no book has given real information on the adjustment and operation of any particular make. There has been a vital need for just this kind of information.

The editorial staff of DIESEL POWER yielded to this insistent demand—and with the help of the DIESEL builders' Service Departments, has prepared the DIESEL OPERATORS' GUIDE AND DATA BOOK.

This book now ready for distribution contains pages and pages (totaling in the hundreds) of operation and maintenance instructions.

A whole chapter is devoted to each particular Diesel.

In addition, there are 100 pages of data on erection, accessories, etc.

The volume is available in two editions.

The DeLuxe Edition, priced at $6.00, is printed on 70-lb., high-grade coated paper and is bound in red leatherette, with gold title.

The Standard Edition is priced at $5.00 and is bound in green book cloth with black title. The contents of both books are identical.

CA—12-37

DIESEL PUBLICATIONS, INC.
192 Lexington Ave., New York City

Send me postpaid a copy of the DIESEL OPERATORS' GUIDE AND DATA BOOK. I enclose $.....I wish the

☐ DeLuxe Edition. Price $6. (Canada, $7; Foreign, $7.50)

☐ Standard Edition. Price $5. (Canada, $6; Foreign, $7.)

Name:—.....
(PLEASE PRINT)

Position:—.....

Street .....

City, State .....

IMPREGNABLE!

In the Allis-Chalmers Seal-Clad Motor the wound stator receives impregnating treatment, similar to the conventional type of winding. Then a Moulded Shield of high dielectric and mechanical strength is fitted into a machined slot in the stator frame and tightly sealed into position with a special compound—thus giving complete protection to the coils.

This feature makes Allis-Chalmers Seal-Clad Motors impregnable to metallic dust, grit, oil, moisture, chemicals and other agents destructive to motor windings.

One or more of these destructive agents are present in every plant, to a greater or lesser degree . . . so why take a chance?

If your plant conditions are severe, the ultimate in motor protection is essential to you—Allis-Chalmers Seal-Clad Motors offer the ultimate in motor protection. If your plant conditions are not so severe as to make this protection absolutely essential, Allis-Chalmers Seal-Clad Motors are still the soundest investment you can make, BECAUSE YOU ARE GIVEN THIS GREAT ADDITIONAL PROTECTION AT NO ADDITIONAL COST.

For further details, write today for Leaflet No. 2182.

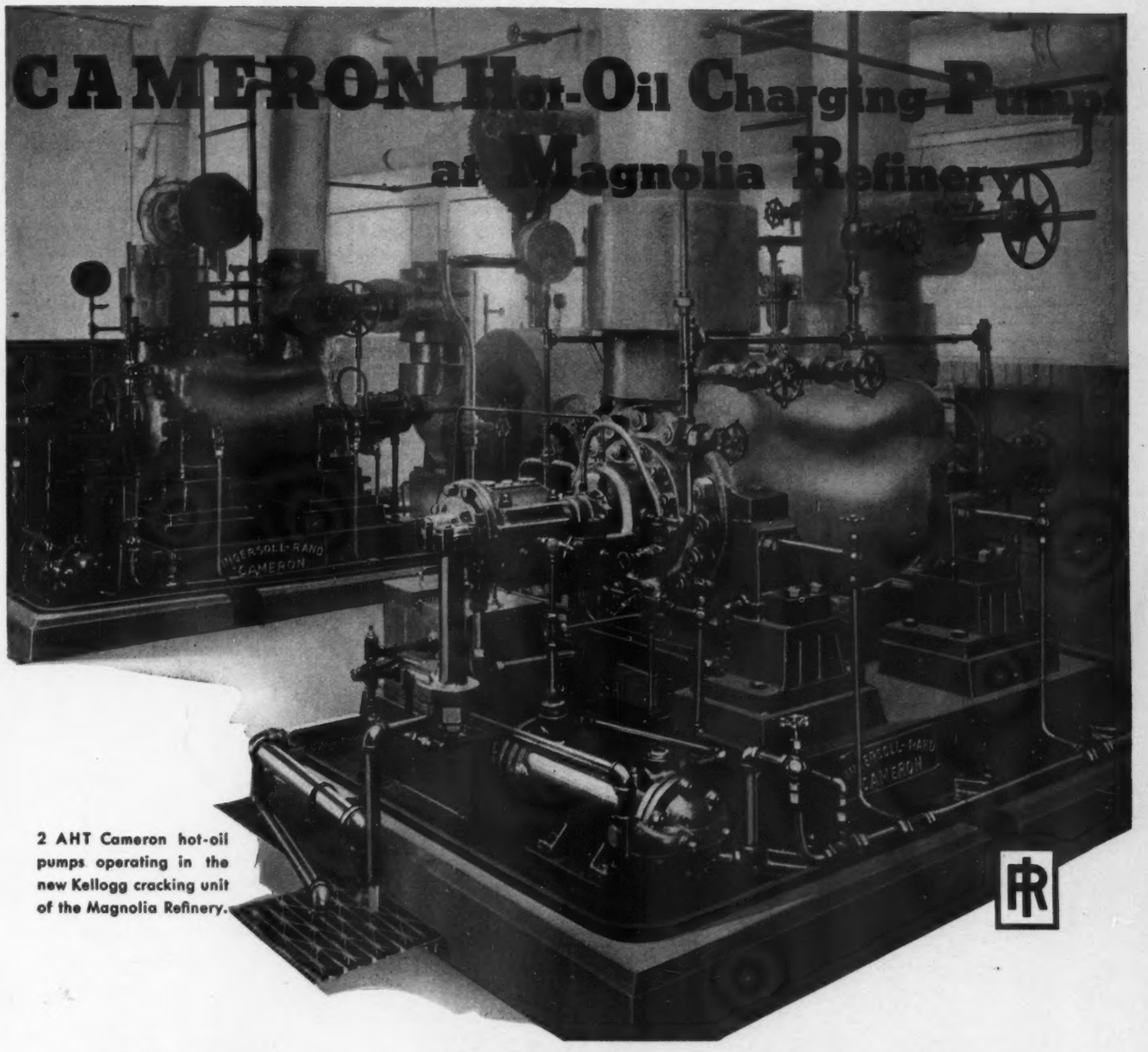
The Allis-Chalmers Mfg. Co. builds standard motors of every type from 1 hp. up—also motors for special application.

7N8

MOTOR DIVISION

ALLIS·CHALMERS

MILWAUKEE · WISCONSIN



2 AHT Cameron hot-oil pumps operating in the new Kellogg cracking unit of the Magnolia Refinery.

Performance Records Tell the Story

The widespread endorsement of Cameron Hot-Oil cracking-coil charging pumps has been the result of their exceptional performance records.

In a large number of refineries the AHT has proved its dependability by many thousands of hours of operation without the usual long delays and high costs needed for repairs and dismantling. AHT Pumps can always be relied upon to maintain high efficiency and full capacity.

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cleveland, Dallas, Denver, Detroit, Duluth, El Paso, Hartford, Houston, Knoxville

Ingersoll-Rand

11 BROADWAY, NEW YORK CITY 358-10

Los Angeles, Newark, New York, Philadelphia, Picher, Pittsburgh, Pottsville, Salt Lake City, San Francisco, Scranton, Seattle, St. Louis, Tulsa, Washington

PLUS VALUE NO. 2

GEAR CAPACITY MATCHES MOTOR CAPACITY

GEARMOTORS offer you an opportunity for decreasing costs just as they have in many other plants where they have replaced obsolete, inefficient drives. Often, these savings pay for the installation in two or three years.

Before purchasing any slow speed drive weigh the advantages of the Westinghouse gearmotor design. From the motor terminal to the slow speed shaft it is packed full of plus value.

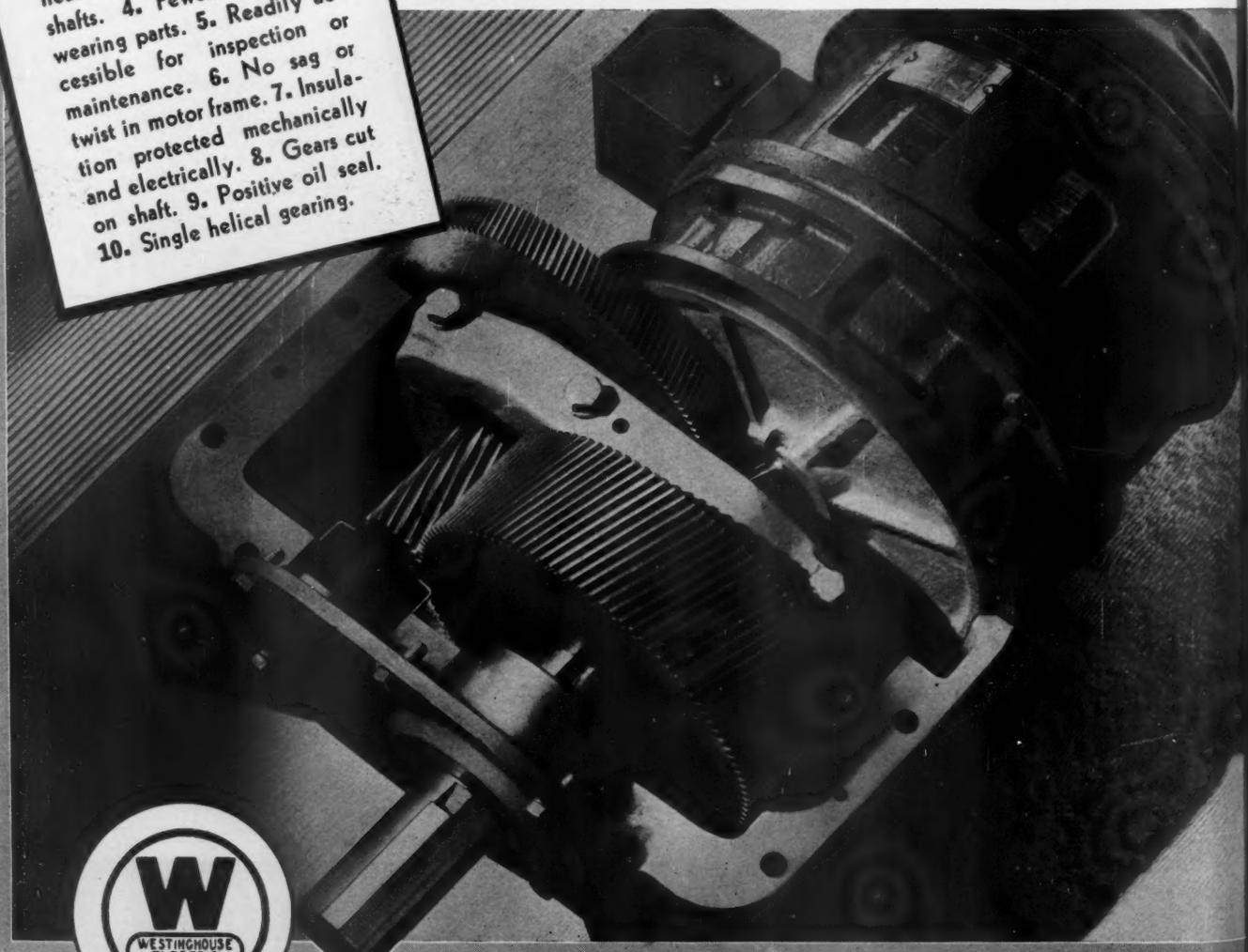
For example, the gearing capacity is accurately matched to motor capacity. The rigid cast frame, and all working parts are strong enough to transmit the maximum torque the motor will develop. In addition, a standard Westinghouse gearmotor will transmit the load even if power takeoff is by sprocket or pinion with a diameter only twice that of the output shaft.

When considering the purchase of any slow speed drive check over the list of plus values found in Westinghouse gearmotors. Complete information can be obtained from our nearest representative or write Westinghouse, Room 5-N, East Pittsburgh, Pennsylvania.

R 65031

Check THESE PLUS VALUES

1. Built, designed, tested as a unit. 2. Motor and gearing parts are matched. 3. BPT heat treated gears, pinions and shafts. 4. Fewest moving & wearing parts. 5. Readily accessible for inspection or maintenance. 6. No sag or twist in motor frame. 7. Insulation protected mechanically and electrically. 8. Gears cut on shaft. 9. Positive oil seal. 10. Single helical gearing.



W WESTINGHOUSE ELECTRIC

Westinghouse Gearmotors

NEW JENKINS 'ARMOR-SEAT'

Defeats Toughest Valve Enemies

This Jenkins Valve has a PLUG SEAT made of Jenkins JX500 stainless steel EXCEEDING 500 BRINELL HARDNESS

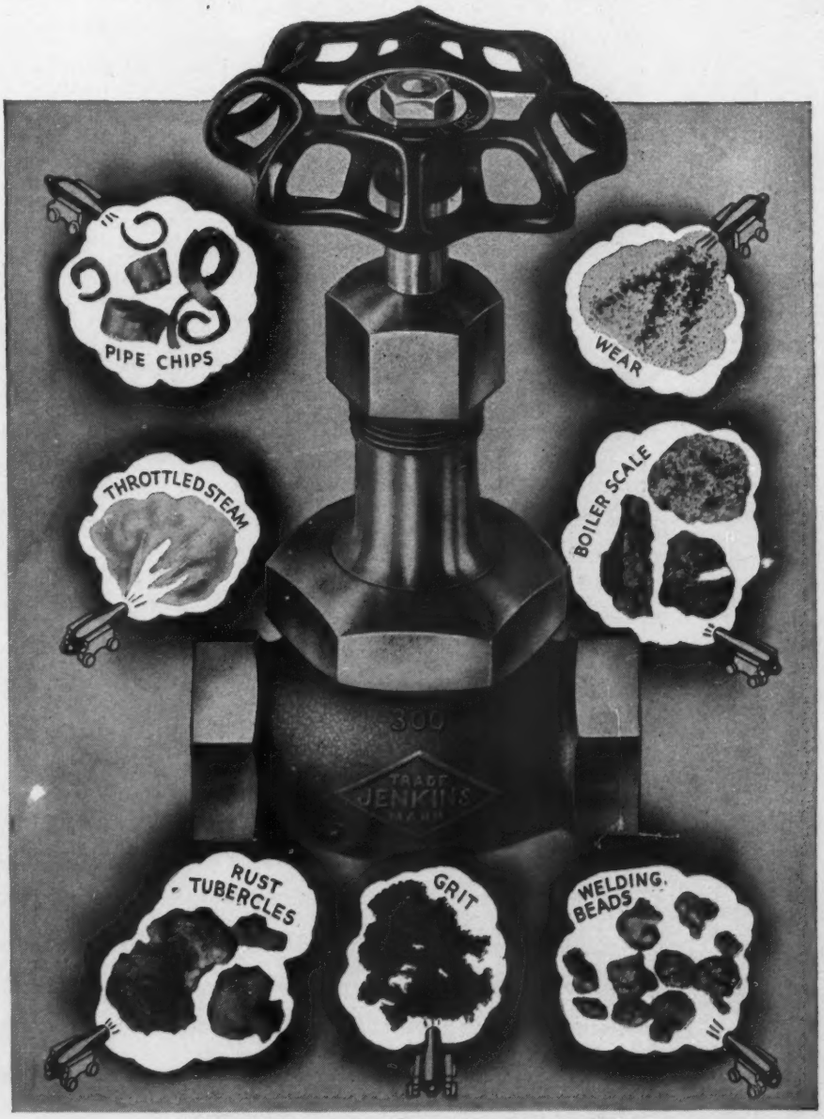
In presenting this Fig. 976 Plug-Seat Valve, Jenkins Bros. is confident that it is as near to being wear-proof, maintenance-proof and trouble-proof as a stock valve can be made. Back of it is a long period of development and testing to prepare it for the toughest services.

Natural enemies of valve seats such as boiler scale, pipe chips, grit and other substances commonly encountered in pipe lines, cannot injure the seating parts. Plug and seat ring are made of Jenkins JX500, a superior stainless steel having a Brinell hardness in excess of 500. Maximum wear-resistance is obtained and maintenance, due to seat damage, is reduced to the lowest possible degree.

Put this Jenkins to a service test on the worst place you know... continuous throttling for pressure reduction or free blow duty such as soot blowers, injectors, heating coils, or on any steam line where close regulation is required. Fig. 976 is specially recommended where such severe service is encountered. The JX500 plug and seat practically nullify wear and almost entirely eliminate danger of wire drawing and cutting.

If you have a tough valve job we ask only that you let this new Fig. 976 show what it can save you in maintenance and replacement expense. Ask your supply house for complete information, or write us.

JENKINS BROS., 80 White Street, New York; 510 Main Street, Bridgeport; 524 Atlantic Ave., Boston; 133 North Seventh Street, Philadelphia; 822 Washington Boulevard., Chicago; JENKINS BROS., Limited, Montreal, Can.; London, England

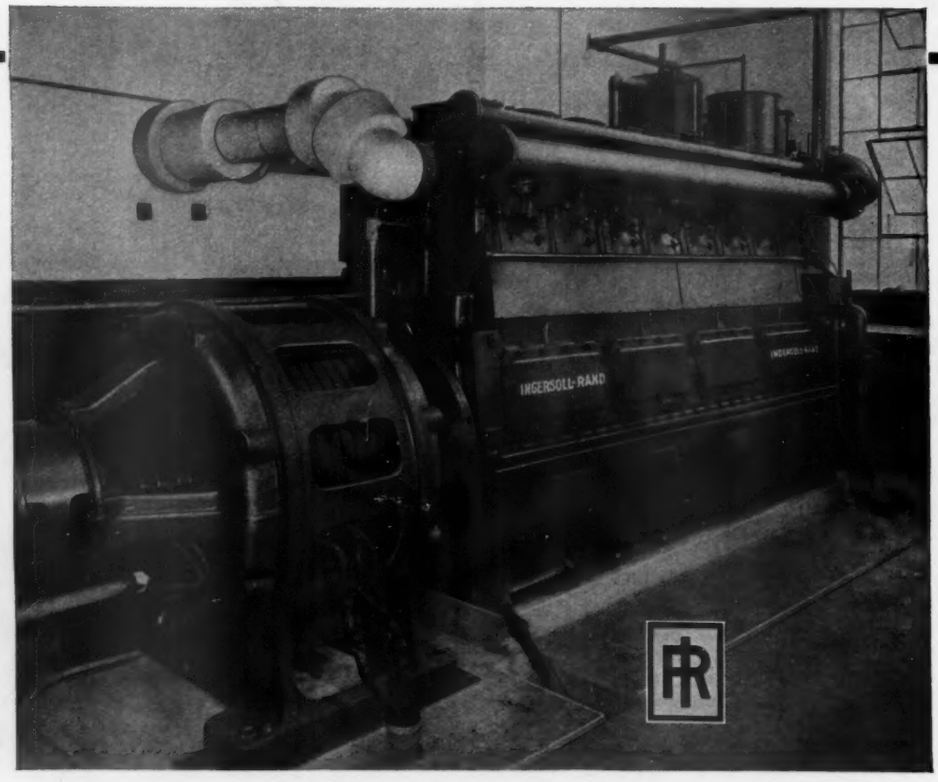


Illustrated is Fig. 976 for 300 lbs. W.S.P., or 600 lbs. O.W.G.

HOW HARD IS 500 BRINELL? Nothing that would conceivably get into the valve could scratch the Jenkins JX500 stainless steel seat. Compare 500 Brinell hardness with the hardness of some substances which do get into pipe lines... boiler scale, pipe chips, welding beads, rust tubercles, iron oxides... even with other familiar objects that are softer, such as a common nail which is under 200 Brinell hardness.

Jenkins Valves MADE FOR LIFETIME SERVICE

Type S Diesel Proves Economical in Paper Mill



THE Hinsdale Paper Manufacturing Company at Hinsdale, N. H. uses Diesel, water and steam power in its modern mill.

The Diesel engine is an 8 cylinder, 10 x 12 I-R Type S unit. It drives a 300 kw., 440 volt alternating current generator.

The Type S unit is ideal for such applications because of its high operating economy, low installation and maintenance costs and ease of operation.

Such features as force feed lubrication throughout, a fully enclosed engine, conservative rating, dynamically balanced crankshaft and an efficient cooling system insure long life and maintained operating economy.

Perhaps a Type S Diesel will help reduce your power costs. Why not ask an I-R engineer to investigate.

Reprints of an article describing the power arrangements at the Hinsdale Paper Manufacturing Co. are available on request.

Atlanta
Birmingham
Boston
Buffalo
Butte
Chicago
Cleveland
Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Kansas City

Ingersoll-Rand
11 BROADWAY, NEW YORK CITY

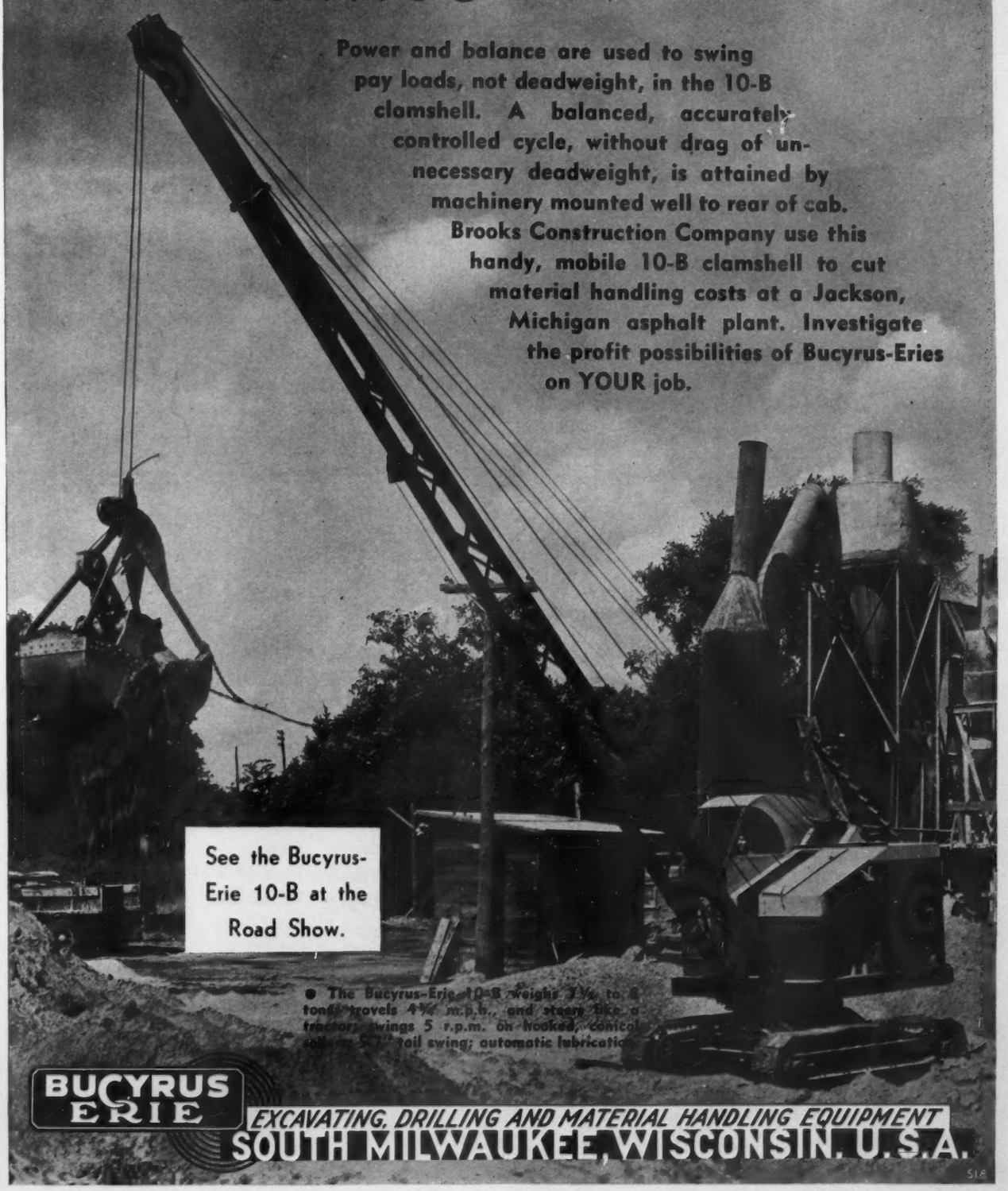
Knoxville
Los Angeles
Newark
New York
Philadelphia
Picher
Pittsburgh
Pottsville
Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
Tulsa
Washington

555-7

BUCYRUS-ERIE

Balance » »

Power and balance are used to swing pay loads, not deadweight, in the 10-B clamshell. A balanced, accurately controlled cycle, without drag of unnecessary deadweight, is attained by machinery mounted well to rear of cab. Brooks Construction Company use this handy, mobile 10-B clamshell to cut material handling costs at a Jackson, Michigan asphalt plant. Investigate the profit possibilities of Bucyrus-Eries on YOUR job.



See the Bucyrus-Erie 10-B at the Road Show.

● The Bucyrus-Erie 10-B weighs 7½ to 8 tons, travels 4¾ m.p.h., and steers like a tractor; swings 5 r.p.m. on hooked, conical coil; 57" tail swing; automatic lubricatio

BUCYRUS ERIE

EXCAVATING, DRILLING AND MATERIAL HANDLING EQUIPMENT

SOUTH MILWAUKEE, WISCONSIN, U.S.A.

518

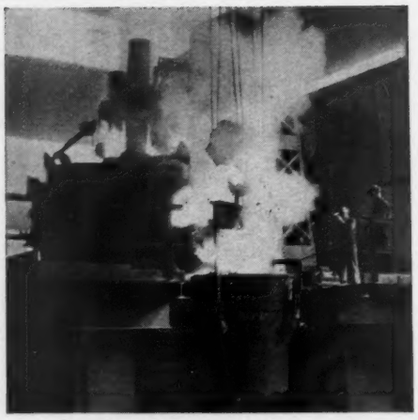
Designed for adequate and efficient lubrication of prime mover and compressor cylinders, this unit is simple, sturdy and reliable. Inquiries are invited. Descriptive matter on request.

THE TORRINGTON MFG. CO.
INCORPORATED 1885
TORRINGTON . . CONNECTICUT

Control
—right from the Start for—

NF

BASIC ELECTRIC STEEL FORGINGS



COMPLETE control of all processing from selection of the melting charge to the finished condition is the N. F. & O. *guarantee of quality* in forgings furnished to your specifications—Smooth Forged, Hollow Bored, Rough or Finished Machined.

NATIONAL FORGE & ORDNANCE CO.
IRVINE, WARREN COUNTY, PENNA. U.S.A.

"DriAir" gives Dry Air

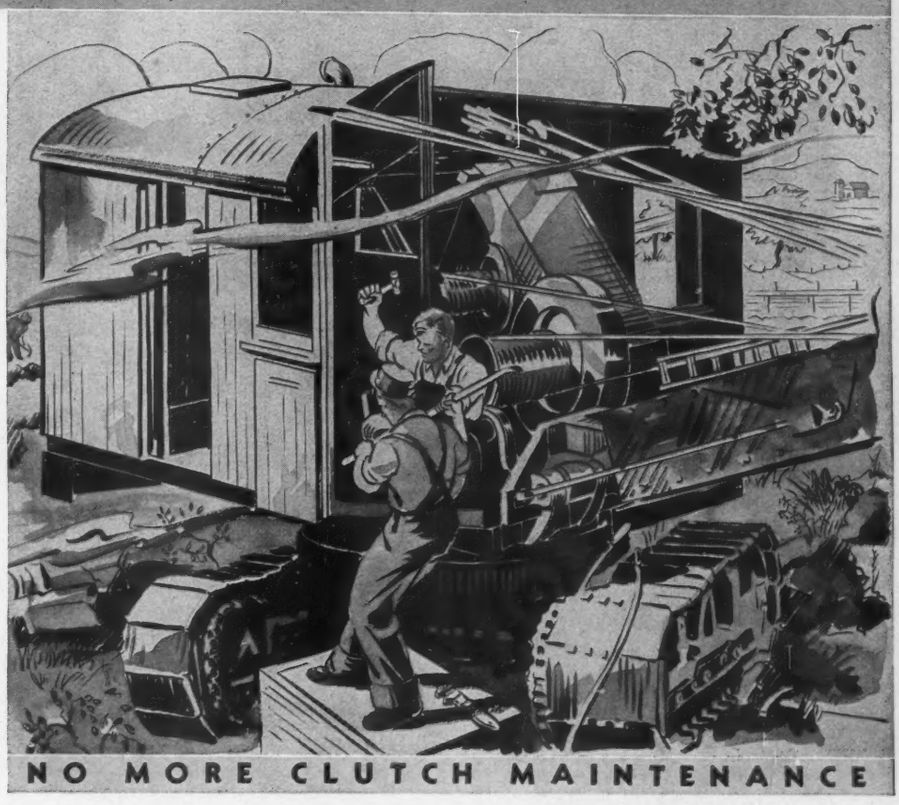
DriAir hangs from the piping above or stands on the floor below. Being a separator and trap combined into a single unit, it requires no attachments, pipes straight through and when once installed requires no further attention.

The DriAir Separator separates and automatically ejects the condensed water from compressed air lines; collects rust, pipe scale, sediment and dirt from the pipes; delivers clean, dry air to tools and other pneumatic equipment. This promotes better and more uniform lubrication and prevents rapid wear, freezing and rusting of tools. The increase in production and the saving in tool depreciation quickly pay for the cost of installing the DriAir.

Do you want Bulletin DA and prices?

NEW JERSEY METER CO.
PLAINFIELD, NEW JERSEY
Air Meters DriAir Separators Air Jet Blowers

For Small Shovels, Too, Electric Drive Costs Less for Upkeep



DEPENDABLE as the power that lights your home, electricity as the drive for your small power shovels will enable you to excavate more tonnage and to excavate it more rapidly than a friction-driven shovel. Electrical acceleration is faster and smoother, and there is less time out for clutch maintenance and other repairs.

The greater availability and speed of electric shovels has been demonstrated repeatedly on the big power shovels.* Why not apply the same advantages to the jobs where you use small ones?

By means of either variable-voltage or rheostatic control, changes in speed are made instantly and with but infinitesimal mechanical wear. Furthermore, with electric drive, the diesel engine or gasoline engine driving the generator operates continuously at its most efficient speed. Thus you get the maximum efficiency of the engine continuously. General Electric, Schenectady, N. Y.

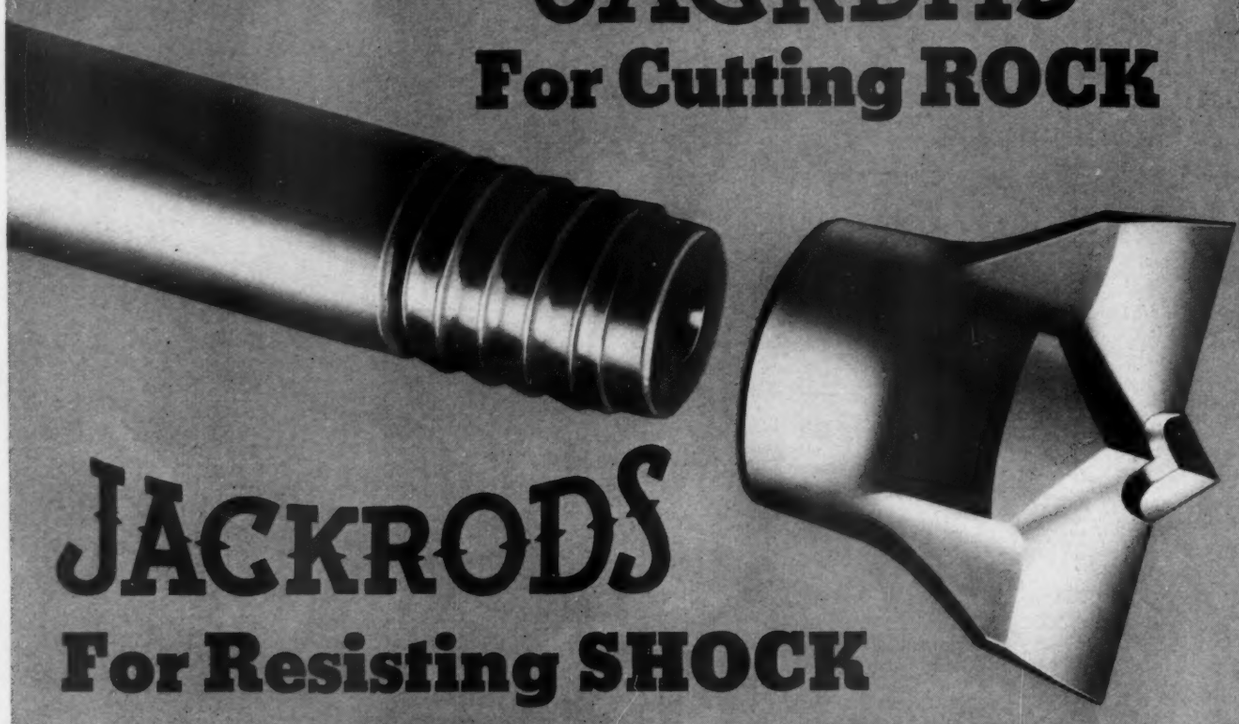
*One contractor wrote that he took his G-E equipped shovel out of service temporarily, not because it was necessary to do so, but because he felt that any equipment that had been in operation for five years without interruption should have a rest.

YOU GET SPEED FOR THE JOB, MORE SERVICE FOR YOUR MONEY, WHEN YOU SPECIFY G-E EQUIPMENT

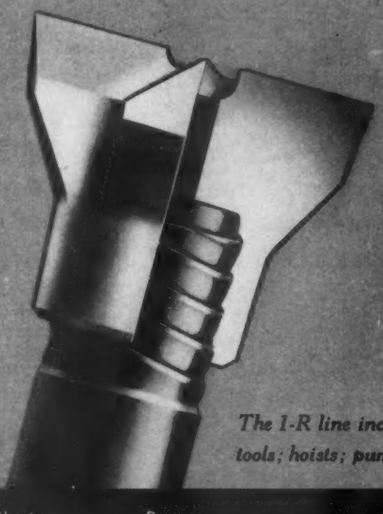
011-236H

GENERAL ELECTRIC

JACKBITS
For Cutting ROCK



JACKRODS
For Resisting SHOCK



- **JACKBITS** are made of a special steel that has been perfected for the sole purpose of cutting rock.

JACKRODS are made of a special steel that has been perfected to withstand the shock of thousands of heavy blows per minute.

Thus, by combining the Jackbits and Jackrods into one drilling unit you obtain the full advantages of each type of steel. Naturally, the combined unit will then drill faster and further. The use of Jackbits reduces drilling costs from 10 to 40%.

At the left is shown the hardness area of a typical Jackbit. The proper hardness depth and shape for each size and type of bit is obtained by scientific heat treatment with modern precision equipment. This permits the maximum number of regrinds for each bit.

If you are not already using Jackbits and Jackrods, we think we can help you save money. Why not get in touch today with our nearest I-R branch office or Jackbit dealer. You will also want to send for our Jackbit price catalogue, Form 2304.

The I-R line includes 1000 sizes and types of air compressors; over 500 different rock drills and pneumatic tools; hoists; pumps and engines for mines, quarries and contractors. Let us help you with your problems.

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cleveland, Dallas, Denver, Detroit, Duluth, El Paso, Hartford, Houston, Knoxville

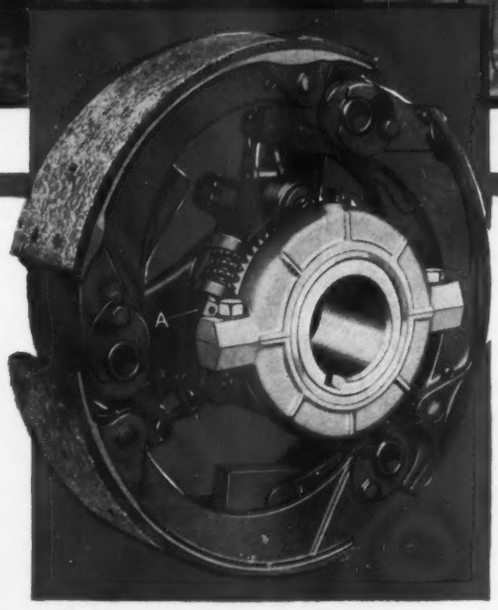
Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

Los Angeles, Newark, New York, Philadelphia, Picher, Pittsburgh, Pottsville, Salt Lake City, San Francisco, Scranton, Seattle, St. Louis, Tulsa, Washington

363-15

A modern Two-Stage, Air-Cooled, Ingersoll-Rand Portable Air Compressor on a road-improvement project.



The outstanding features of this heavy duty Industrial clutch are its single screw adjustment (A), one point lubrication and open-type internal expanding design. There are no torque strains on engaging devices. It is simple in action and perfectly balanced. Its open construction invites inspection and quickly carries away engine heat.

BE SURE THAT YOU GET A MODERN CLUTCH IN NEW MACHINES YOU BUY

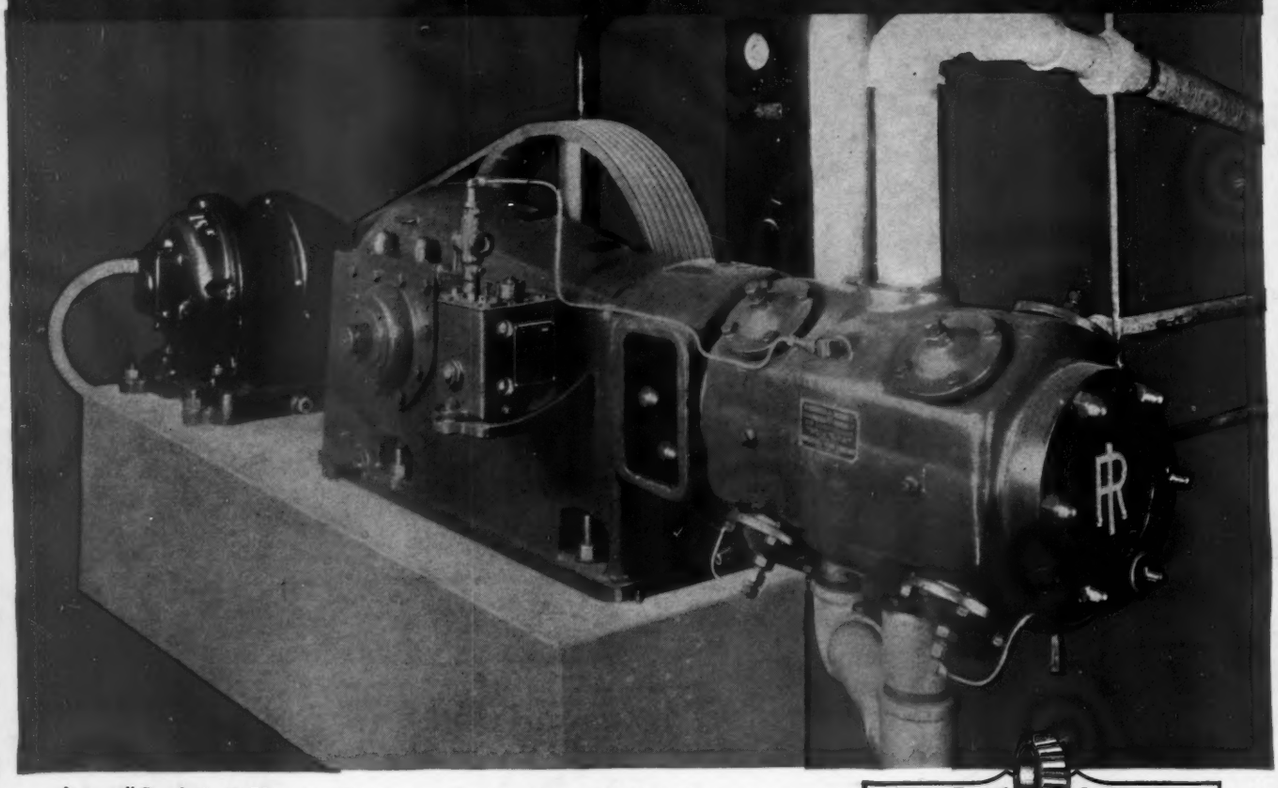
Industrial Clutches are thoroughly modern. You can depend upon them to take the constant shock of "on-off" loads thousands of times a day . . . to stand up over long years of hard work such as is encountered in such services as portable compressors, pumps, shovels—and a wide range of industrial applications. Let us help you solve your clutch problems.

VISIT THE CLEVELAND ROAD SHOW JAN. 17th. - JAN. 21st. BOOTH NO. E36-E55

INDUSTRIAL CLUTCH COMPANY

WAUKESHA WISCONSIN

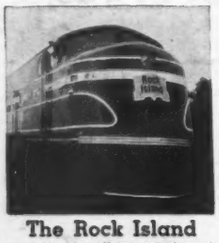
Every Anti-Friction Advantage with TIMKEN Bearings



Ingersoll-Rand 7x7 ES-1 Air Compressor equipped with TIMKEN Bearings. Installed in the plant of the Lily Tulip Corp.

Tapered Roller TIMKEN BEARING EQUIPPED

A symbol of quality for any piece of equipment with which it is associated



The Rock Island "Rockets" Roll On TIMKEN Bearings

GLIDE—as you ride a Timken-equipped train

Efficiency in anti-frictionized compressors is found in greater or lesser degrees—dependent on the kind of bearings used.

When compressor crankshafts are mounted on TIMKEN Bearings every anti-friction advantage is assured for TIMKEN Bearings carry all loads, thrust, radial or any combination of the two. They not only cut power and maintenance costs and prevent shaft wear but more important, TIMKEN Bearings hold the crankshaft in permanent, rigid alignment.

When you specify anti-frictionized compressors add two more words "Timken-equipped"; those two words mean—the most anti-frictionization has to offer.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; Timken Rock Bits; and Timken Fuel Injection Equipment.

TIMKEN

TAPERED ROLLER BEARINGS